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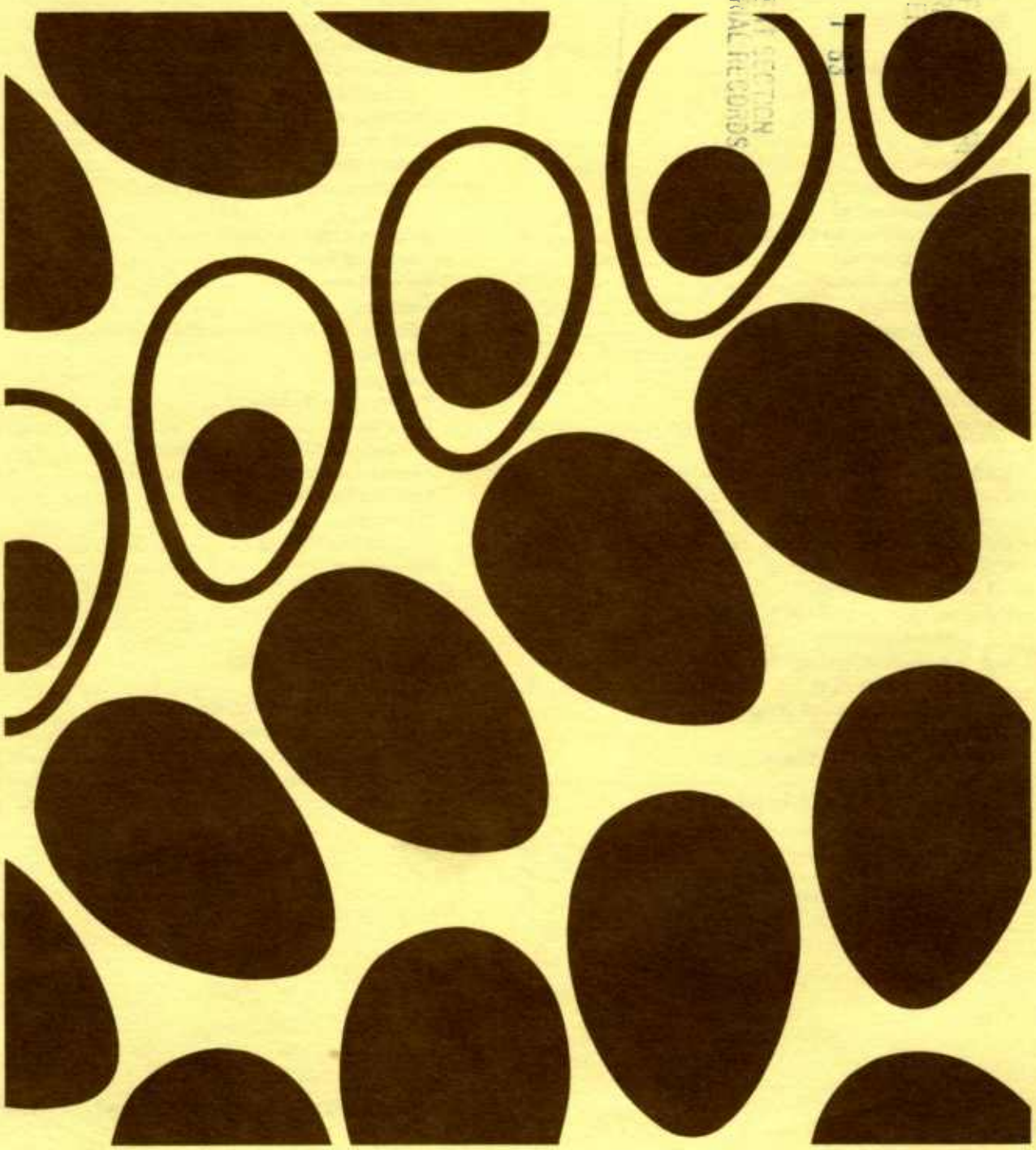
Egg-Grading Manual



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Introduction

The egg is a biological structure intended by nature for reproduction of the chicken. It protects the developing chick embryo, provides a complete diet for it, and serves as the principal source of food for the first few days of the baby chicken's life. The egg is one of the most nutritious and versatile of human foods. As chickens now produce eggs in abundance, this source of food has become extremely important throughout the world, nutritionally as well as economically.

This manual was prepared as an aid in teaching both beginning and experienced egg graders the correct interpretation and application of the U.S. standards, grades, and weight classes for shell eggs. It is intended to serve as a guide in short courses or grading schools and its use should be supplemented with lectures, group discussions, and demonstrations as needed. This manual should also prove useful to those teaching the marketing of eggs in high schools and colleges.

Descriptions of the various qualities of individual eggs should assist the student grader in understanding egg quality. But it is imperative that the descriptions of the different qualities be compared with eggs before the candling light and that the quality interpretations be checked by experienced graders.

The importance of practice in candling cannot be stressed too much. It is essential that student graders become thoroughly familiar with the descriptions of the different qualities because the final measure of their ability is the accuracy of their interpretation of quality before the candling light. Occasional comparisons of broken-out appearance with candled appearance are also essential in developing grading skill.

The modern trend in production is toward large, highly specialized flocks. The high-quality egg produced under this system lends itself very well to the use of machine-flash candling equipment, such as bulk or mass scanning devices, to detect checks, irregular shells, meat and blood spots, and loss eggs. For this reason, it is highly desirable for graders to have a working knowledge of these systems.

Egg quality and grading procedures are the "what" and "how" of the job. Coupled with reasonably good judgment, practice, and guidance, graders should acquire the necessary skill to determine rapidly the proper classification of shell eggs according to official standards of quality.

To be better than average, graders should have background information on the reasons why grading of eggs is necessary. This includes information about the formation, structure, and composition of the egg, the production and conservation of egg quality, and Federal-State grading programs.

Although some of this material is only indirectly related to the actual grading function, knowledge of it will help graders do a better job in handling eggs and in maintaining their quality. Such information will help graders, particularly those in charge of egg-candling rooms, to have a better appreciation and understanding of their job, and will aid them in acquiring a reputation for competence and in gaining the respect of their fellow workers.

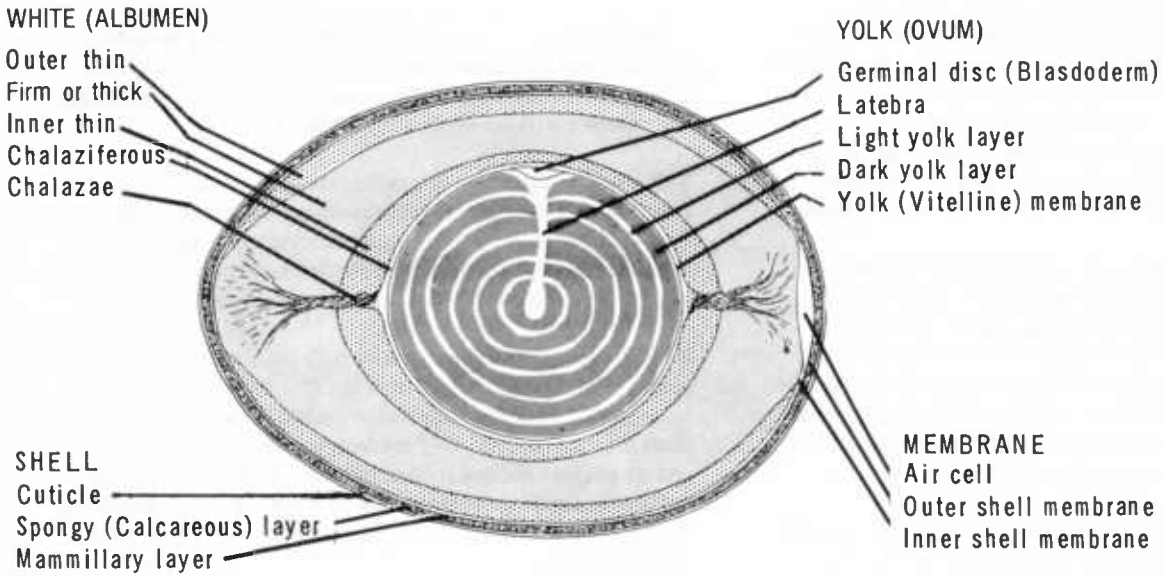

Figure 1.—The parts of an egg.

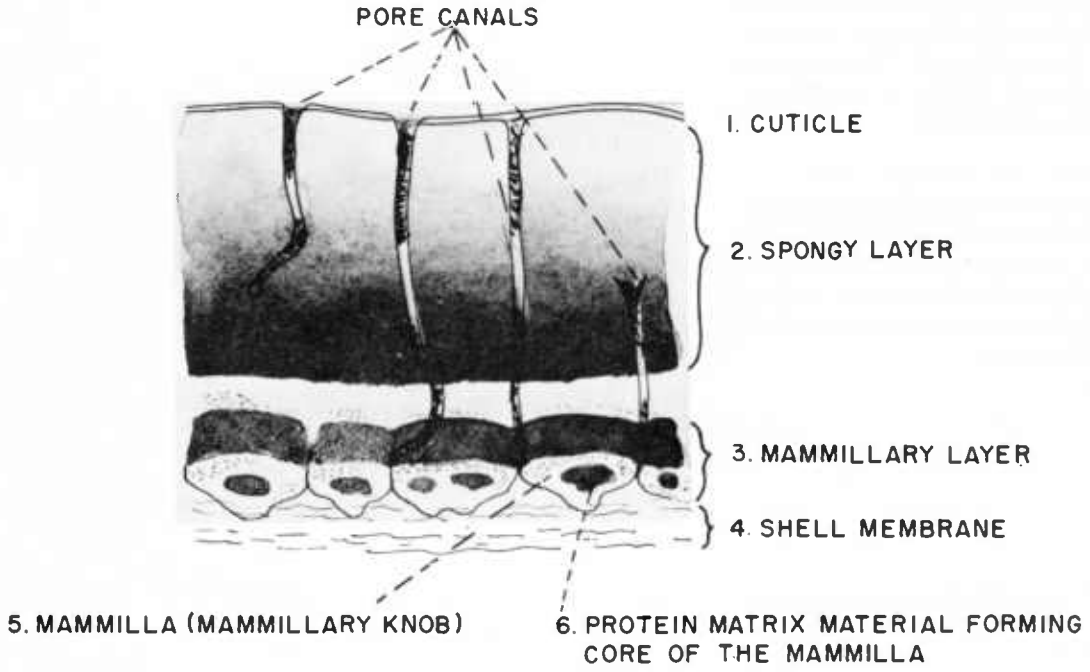

Figure 2.—Magnified radial section through the shell.

Structure, Composition, and Formation of the Egg

Physical Structure

An average chicken egg weighs about 57 grams or 2 ounces.

The parts of an egg are the yolk, the white, the shell membranes, and the shell (figs. 1 and 2).

Yolk (Ovum). The yolk consists of the *latebra, germinal disc*, concentric rings of *yolk material,* and the *vitelline membrane* (a colorless membrane) which surrounds and contains the yolk. The yolk constitutes approximately 31 percent of the total weight of the egg.

White (Albumen). The white consists of several layers which together constitute about 56 percent of the weight of the egg.

The *chalaziferous* layer immediately surrounds the yolk and is continuous with the *chalazea* (pronounced kah-lay-za). This is a very firm but very thin layer of white and makes up 3 percent of the total white.

The *inner thin* layer surrounds the chalaziferous layer and comprises about 17 percent of the white.

The *firm or thick* layer of white provides an envelope or jacket that holds the inner thin white and the yolk. It adheres to the shell membrane at each end of the egg. Approximately 57 percent of the white is firm white.

The *outer thin* layer lies just inside the shell membranes except where the thick white is attached to the shell, and accounts for about 23 percent of the total white.

Shell Membranes. The shell membranes are tough and fibrous and are composed chiefly of protein, similar in nature to that in hair and feathers. The *inner* membrane is thinner than the *outer* and together they are only about twenty-four ten-thousandths of an inch thick.

Shell. The shell is composed of three layers and constitutes approximately 11 percent of the egg.

The *mammillary or inner* layer covers the outer shell membrane. Next is the *spongy* layer, then the *cuticle*. *Pores* connect the surface and the mammilla.

The egg, as laid, normally has no *air cell*. It forms as the egg cools, usually in the large end of the egg, and develops between the shell membranes. The air cell is formed as a result of the different rates of contraction between the shell and its contents.

Composition

The egg is a very good source of high-quality protein and of certain minerals and vitamins. The chemical composition of the egg, including the shell, is summarized in table 1.

White. The protein of egg is complete; it contains all of the indispensable amino acids in well-balanced proportions.

The thick white is made up mainly of the proteins ovomucin, ovalbumen, conalbumin, ovoglobulin, and ovomucoid. Ovomucin gives structure to the thick white.

The thin white is composed mostly of proteins of the same kind as contained in the thick white with the exception of ovomucin.

The white also contains some water-soluble B vitamins, especially riboflavin. The latter gives the greenish tint to the white.

Yolk. The important yolk proteins are ovovitellin (about three-fourths of the yolk protein) and ovolivetin.

The fatty substances of the yolk are mostly glycerides (true fat), ovolecithin, and cholestrol.

Yolk pigments (mostly xanthophyll) come from green plants and yellow corn that the birds eat.

The yolk contains practically all of the known vitamins except vitamin C. The vitelline membrane is mostly protein similar to that of the shell membranes and is fairly permeable to water. The higher concentration of the solids of the yolk causes the yolk to increase in size and become less viscous because of the inflow of water from the white as the egg ages.

The yolk contains iron, phosphorus, sulphur, copper, potassium, sodium, magnesium, calcium, chlorine, and manganese, all of which are essential elements.

Table 1. — Chemical composition of the egg

		Water	Protein	Fat	Ash
			Percent		
Whole egg	100	65.5	11.8	11.0	11.7
White	58	88.0	11.0	0.2	0.8
Yolk	31	48.0	17.5	32.5	2.0
		Calcium carbonate	Magnesium carbonate	Calcium phosphate	Organic matter
			Percent		
Shell	11	94.0	1.0	1.0	4.0

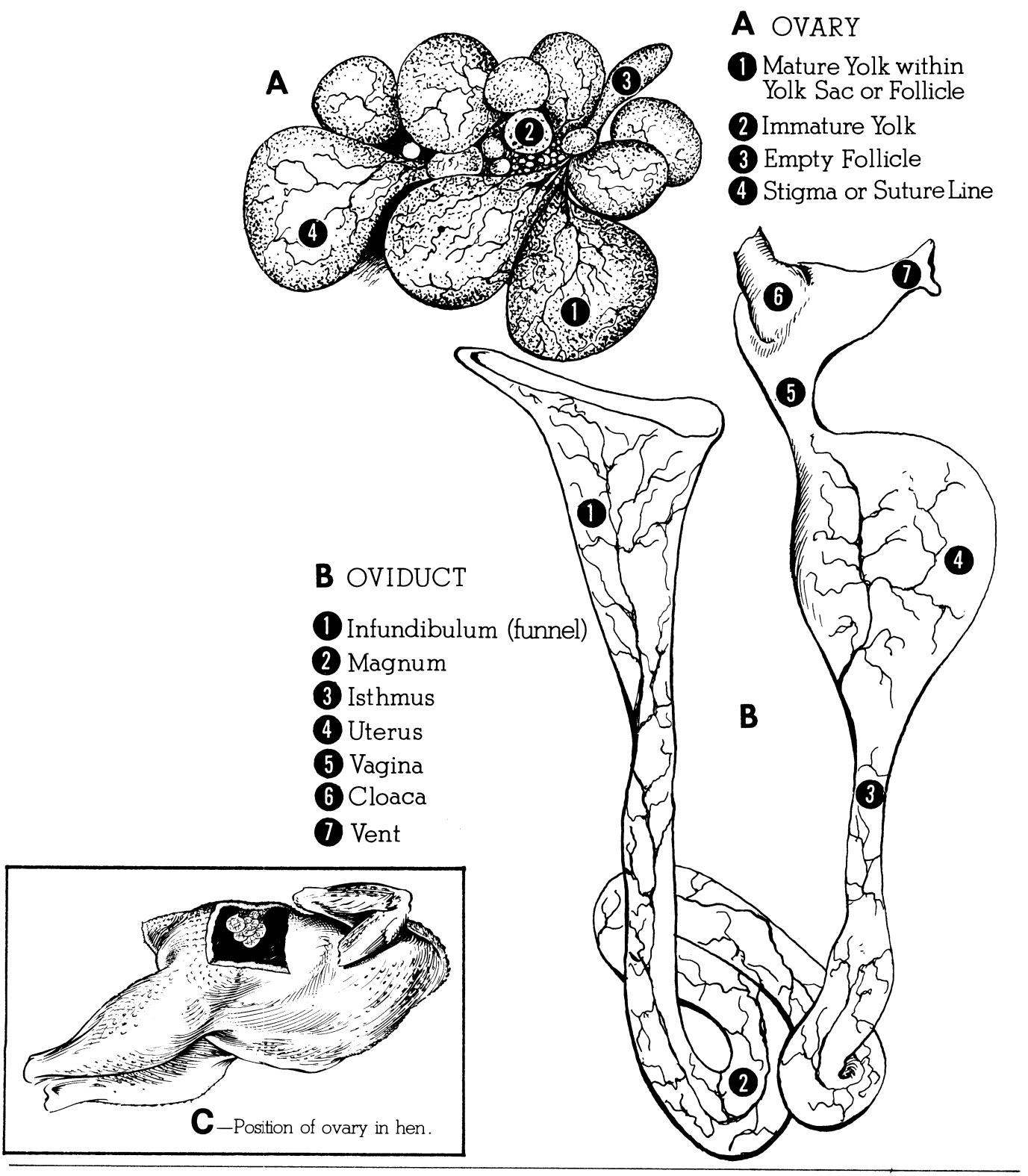

Figure 3.—Enlarged drawings of reproductive system of the hen.

Formation

The reproductive system of the hen is divided into two main parts: Ovary and oviduct (fig. 3). Most female animals possess both a right and a left functioning ovary but in the hen, the right ovary and oviduct normally remain dormant and the left ovary and oviduct develop the egg.

The *Ovary*—This is a cluster of developing yolks, each separate from the others, attached to the middle part of the back about midway between the neck and the tail. This organ is fully formed, although very small, when the chick is hatched. It contains approximately 3,600 to 4,000 minute ova (future yolks) each within its own sac or follicle.

The *Oviduct*—This is a long, tubelike organ lying along the backbone and attached to it loosely between the ovary and the tail. It is approximately 25 to 27 inches long, and may be divided into five areas which perform certain functions in completing the formation of the egg. It is here that the white, shell membranes, and shell are secreted.

Formation of the Yolk

Each yolk within the ovary starts as a single cell (female reproductive cell or germ) with the vitelline membrane around it.

The yolk develops slowly at first by the gradual addition of yolk fluid. Fat soluble dyes, normally xanthophyll, are transferred rapidly from the digestive tract to the blood stream and then to the yolk. Occasionally, what appears to be concentric layers of alternate dark- and light-colored yolk fluid may be observed. However, modern feeding and production practices have reduced the frequency of this occurrence.

The yolk matures as more yolk fluid is added. The germ stays at the surface of the yolk, leaving a tubelike structure, the latebra, extending to the center of the yolk.

An accelerated stage occurs 8 to 10 days before ovulation. This stage is initiated by the stimulating hormone of the pituitary gland. The hormones secreted by the ovary in turn stimulate the oviduct to activity. The rate of yolk secretion increases rapidly from the 9th to 2d day before ovulation (0.5 to 2.8 grams of yolk per day) and decreases thereafter.

Ovulation is the release of a *mature yolk* (ovum) from the ovary. Each developing yolk is enclosed in a *yolk sac* in which many blood vessels are profusely distributed. These blood vessels carry yolk-building substances to the developing yolk. One particular area of the yolk sac is free of blood vessels (*stigma or suture line*) and it is normally here that ovulation or release of the mature yolk takes place. However, the rupture of the yolk sac and release of the yolk sometimes occur at other than the stigma, with the result that one or more blood vessels are ruptured and blood spots occur on the yolk, or the white becomes bloody.

Occasionally, reddish brown, brown, tan, or white spots commonly known as "meat spots" may be found in the egg. It has been demonstrated that meat spots may be either blood spots which have changed, mostly in color due to chemical action, or tissue sloughed off from the reproductive organs of the hen.

Ovulation occurs again about 30 minutes after an egg is laid, during the laying clutch of a good producing hen.

Formation of the White

The first part of the oviduct, usually 3 or 4 inches long, is the *infundibulum*, commonly called the funnel. It opens into the body cavity. When ovulation occurs, the funnel engulfs the yolk and starts it on its way down the oviduct.

Although the main function of the funnel is to pick up the yolk, it also serves as a reservoir for male sperm which, if present, fertilize the germ and set up embryonic growth. The yolk moves through the infundibulum or funnel to the magnum in about 15 minutes. Movement is brought about by peristaltic action.

The *magnum* area is about 15 inches long and the time required for the yolk to travel through its length is about 3 hours. It is here that three of the four layers of the white are formed, and practically all the protein in the white is secreted.

The white contains ovomucin, secreted by the magnum as fibers or strands, which make the white thick. These strands draw together as the developing egg continues its spiral movement through the oviduct. From these strands the chalaziferous layer and the chalazae are formed (1st layer). The continued twisting and drawing together of these strands tend to squeeze out thin white to form the inner thin white (2d layer). The remaining thick white is a homogeneous gel (3d layer).

The quality of the white is largely dependent on the amount of ovomucin secreted by this part of the oviduct. The portion of the gel immediately adjacent to the yolk undergoes partial liquefaction before the egg leaves the magnum.

The *isthmus* is a constricted area of the oviduct about 4 inches long, through which the developing egg passes in about 1-1/4 hours. Here some water and mineral salts are added and the two shell membranes are deposited.

The *uterus*, a heavy-walled part of the oviduct, approximately 4 inches in length, is where the developing egg spends about 21 hours. Here the outer thin white (4th layer) and minerals pass through the shell membranes by osmotic pressure and the shell and shell pigment are added. The water and solids content of the white ultimately become equally distributed in the various layers of the white.

Formation of the Shell Membranes

The shell membranes are added as the partly formed egg enters the *isthmus*. The membranes are a closely knit lacelike nitrogenous compound of a substance similar to that present in the chicken's toe nails.

Formation of the Shell

Calcium carbonate comprises about 94 percent of the dry shell. A hen may use as much as 47 percent of her skeletal calcium for egg shell formation. Two layers of the shell are formed in the *uterus*.

The spongy layer consists of small calcite crystals that are not arranged in any order except in the outer portion of the layer where crystals are set at right angles to the shell surface.

Pigment, if any, is laid down in the spongy layer of the shell and is derived from the blood.

Pores are formed through the spongy layer connecting some of the space between the knoblike mammilla with the surface.

Moving finally into the *vagina*, a 2-inch area, the fully formed egg enters the *cloaca* and the *vent*, and is laid. When the egg is laid, the pores are filled by the matrix material and covered by the cuticle.

Cuticle, which is sometimes erroneously referred to as "bloom," is of a chemical composition similar to the shell membrane.

The entire time from ovulation to laying is usually slightly more than 24 hours. About 1/2 hour after a hen has laid an egg, she releases another yolk (ovulation), and it will likewise travel the length of the oviduct.

Abnormalities

Double-yolked eggs result when two yolks are released about the same time or when one yolk is lost into the body cavity for a day and is picked up by the funnel when the next day's yolk is released.

Yolkless eggs are usually formed around a bit of tissue that is sloughed off the ovary or oviduct. This tissue stimulates the secreting glands of the oviduct and a yolkless egg results.

The abnormality of an *egg within an egg* is due to reversal of direction of the egg by the wall of the oviduct. One day's egg is added to the next day's egg and shell is formed around both.

Bloodspots are caused by a rupture of one or more small blood vessels in the yolk follicle at the time of ovulation.

Meat spots have been demonstrated to be either blood spots which have changed in color, due to chemical action, or tissue sloughed off from the reproductive organs of the hen.

Soft-shelled eggs generally occur when an egg is prematurely laid, and insufficient time in the uterus prevents the deposit of the shell.

Thin-shelled eggs may be caused by dietary deficiencies, heredity, or disease.

Glassy- and chalky-shelled eggs are caused by malfunctions of the uterus of the laying bird. Glassy eggs are less porous and will not hatch but may retain their quality.

Off-colored yolks are due to substances in feed that cause off-color.

Off-flavored eggs may be due to certain feed flavors.

Grading

Grading generally involves the sorting of products according to quality, size, weight, and other factors that determine the relative value of the product.

Egg grading is the grouping of eggs into lots having similar characteristics as to quality and weight.

The grading for quality of shell eggs is the classifying of the individual egg according to established standards. U.S. standards for quality of individual shell eggs have been developed on the basis of such interior quality factors as condition of the white and yolk and the size of the air cell, and the exterior quality factors of cleanliness and soundness of the shell. These standards apply to eggs of the domesticated chicken that are in the shell.

Eggs are also classified according to weight (or size) expressed in ounces per dozen. Although eggs are not sold according to exact weight, they are grouped within relatively narrow weight ranges or weight classes, the minimum weight per unit being specified.

Shell Color

Shell color does not affect the quality of the egg and is not a factor in the U.S. standards and grades. Eggs are usually sorted for color and sold as either "whites" or "browns." Eggs that are sorted as to color and packed separately sell better than when sold as "mixed colors."

For many years consumers in some areas of the country have preferred white eggs, believing, perhaps, that the quality is better than that of brown eggs. In other areas consumers have preferred brown eggs, believing they have greater food value. These opinions do not have any basis in fact, but it is recognized that brown eggs are more difficult to classify as to interior quality than are white eggs. It is also more difficult to detect small blood and/or meat spots in brown eggs. Research reports and random sample laying tests show that the incidence of meat spots is significantly higher in brown eggs than in white eggs.

Advantages

Grading aids orderly marketing by reducing waste, confusion, and uncertainty with respect to quality values. The egg production pattern and the marketing system in the United States are such that interstate trading and shipment occur constantly and in large volume. This situation creates a need for uniform standards throughout the United States so that marketing may be facilitated and the efficiency of distribution increased.

Officials of USDA, and State and industry leaders, encourage the use of uniform standards and grades for eggs. Most of the eggs reaching the consumer today are graded and marked according to U.S. standards and grades.

The primary advantage in using official standards and grades for eggs is that they furnish an acceptable common language in trading and marketing the product, thus making possible:

1. Impartial official grading that eliminates the need for personal inspection of the eggs by sellers, buyers and other interested people.
2. Pooling of lots of comparable quality.
3. Development of improved quality at producer level through "buying on grade" programs.
4. Market price reporting in terms understood by all interested parties.
5. Negotiation of loans on generally accepted quality specifications.
6. A basis for settling disputes involving quality.
7. A basis for paying damage claims.
8. A standard upon which advertising may be based.
9. A uniform basis for establishing brand names.
10. Establishment of buying guides for consumers.

General Application

Standards of quality have been developed as a means of classifying individual eggs according to various groups of conditions and characteristics that experience and research have shown to be wanted by producers, dealers, and consumers.

The term "standardization" implies uniformity, and uniformity in interpretation will result if the same standard is used and is applied accurately in all instances.

Standards of quality are used as a basis for establishing grades. Standards of quality apply to individual eggs; grades apply to lots of eggs such as dozens, 30-dozen cases, and carloads. As egg quality is unstable and grading procedures are largely subjective, it is necessary to provide tolerances in grades for small percentages of eggs of a quality lower than that comprising the major part of the grade. The tolerances are provided to allow for errors in judgment, differences in interpretation, and normal deterioration in quality from the time of grading until the eggs are sold to the consumer.

Grades differ from standards in that they provide tolerances for individual eggs within a lot to be of lower quality than the grade name indicates.

Tolerances must be within the capabilities of the industry to produce an acceptable product at reasonable prices. Without tolerances, it would not be possible to produce cartoned eggs at prices acceptable to consumers.

As soon as the grader has acquired a working knowledge of the standards of quality and reasonable dexterity in manipulating individual eggs, candling speed will increase. The accuracy of interpretation of quality standards depends on the ability to develop judgment of correct classification. In efficient commercial operations, each grader must make many grading decisions each day. Therefore, the grader must develop an ability to make instant decisions.

The greatest frequency of error is believed to occur in instances of repeated indecision as to the placement of individual eggs. It should be pointed out that mistakes due to oversight, minor errors in decision, and differences of opinion between graders or between graders and supervisors or inspectors are factors that are taken into consideration in the U.S. grades by providing for tolerances. However, errors beyond the permitted tolerances result in the incorrect grading of the entire lot of eggs. It is most important that each grader's decision of egg placement be as nearly correct as possible.

Speed and accuracy in grading should be accompanied by constant careful handling of the product. When eggs are placed into a carton or filler they should be placed carefully, not dropped. The egg should always be packed small end down. Cartons of eggs should be placed on the conveyor belt carefully, not dropped. Eggs should not be placed into dirty or torn fillers and flats or in packing materials giving off foreign odors.

Eggs received in cases or packing material giving off foreign odors should not be graded unless the egg content is carefully checked for flavor.

Shell eggs held in official plants should be placed under refrigeration of 60° F. or lower promptly after packaging. Officially identified shell eggs with an internal temperature of 70° F. or higher when shipped from the official plant should be transported at a temperature of 60° F. or less.

Every reasonable precaution should be exercised to prevent "sweating" of eggs (when there is condensation of moisture on the shell) in order to avoid smearing and staining the shell. Eggs from a very cool environment should be tempered in the candling or other room with as moderate a temperature as necessary before candling to avoid "sweating" when the eggs are candled.

In acquiring skill in judging egg quality it is helpful to break the classification down into steps, considering separately the various quality factors — shell, air cell, yolk condition, and condition of the white. The operator can concentrate with greater ease when each factor is considered separately. Later, all factors should be considered in combination.

General Quality Factors

Quality may be defined as the inherent properties of a product that determine its degree of excellence. Those conditions and characteristics that consumers want and are willing to pay for are in a broad sense factors of quality. The quality of an egg is determined by comparing a number of factors. The relative merit of one factor alone may determine the quality score of the egg, inasmuch as the final quality score can be no higher than the lowest score given to any one of the quality factors. Quality factors for eggs may be divided into two general groups: Exterior and Interior.

Exterior quality factors are apparent from direct external observation.

Interior quality factors involve the contents of the egg as they appear before a candling light or when the eggs are broken out and measured by the Haugh unit method plus visual examination of the yolk. Both methods are described in detail later in this manual.

Classification of Exterior Quality

The external factors of the egg — shape, soundness, and cleanliness of the shell — can be determined without using the candling light, but soundness of shell should be verified by candling. The method or place where this is accomplished may vary with the type of candling operation used.

In hand candling operations, the examination for shell cleanliness and the removal of leakers or dented checks and misshapen eggs will be accomplished by using the case light.

In flash candling operations, the segregation for these shell factors is quite often the responsibility of a person who scans the eggs for exterior factors prior to or immediately following the mass scanning operation. This should be done in a well-lighted area.

Shell Shape and Texture

The normal egg has an oval shape with one end larger than the other, and it tapers toward the smaller end. These ends of an egg are commonly called the large end (air cell end) and the small end. Investigators measured both strength and appearance of many eggs to develop the "ideal" egg shape.

This ideal egg shape is illustrated in figure 4. The shape of an egg can be considerably different (fig. 5) from the ideal but may still be considered practically normal. The grader must keep a mental picture of the normal or usual shape of an egg and compare each egg with that picture.

Eggs that are unusual in shape may have ridges, rough areas, or thin spots (figs. 6 and 7).

Abnormal shells may result from improper nutrition, disease, or the physical condition of the hen. Sometimes a shell is cracked while the egg is still in the body of the hen. These eggs, which are commonly referred to as "body checks," are repaired by an additional deposit of shell over the cracked area, generally resulting in a ridged area.

Shells with thin areas and some other types of defects are usually weaker than normal shells, and the danger of breakage en route to the consumer lowers the utility value of the egg. Eggs of abnormal shape also lack consumer appeal.

The specifications of the U.S. standards provide degrees of variation:

Practically normal — A shell that approximates the usual shape and is sound and free from thin spots. Ridges and rough areas that do not materially affect the shape and strength of the shell are permitted. (AA or A quality).

Abnormal — A shell that may be somewhat unusual or decidedly misshapen or faulty in soundness or strength or that may show pronounced ridges or thin spots. (B quality).

Soundness of Shell

The shell of an egg may be sound, checked or cracked, or leaking.

Following are definitions of these shell factors:

Sound — An egg whose shell is unbroken.

Check — An individual egg that has a broken shell or crack in the shell but its shell membranes are intact and its contents do not leak.

Leaker — An individual egg that has a crack or break in the shell and shell membranes to the extent that the egg contents are exuding or free to exude through the shell.

Checks are an unavoidable problem in the marketing of eggs because eggs cannot be assembled, graded, packed, transported, and merchandized without some breakage. Such eggs will not keep well or stand even moderately rough handling, and they should be diverted to immediate use.

Checks may range from eggs with plainly visible dented checks that are removed during the grading process to very fine, hairlike checks (blind checks) that often escape detection because they cannot be seen. Many of these checks become detectable as time passes (due primarily to contraction caused by cooling); however, the eggs have usually moved into marketing channels and may be at the retail level within 1 to 3 days after being laid. Blind checks are the most common and frequently the most difficult to detect in rapid candling, being discernible only before the candling light or by "belling."

"Belling" is the practice of gently tapping two eggs together to assist in the detection of "blind checks" by sound. Candlers follow this practice by candling the eggs in order to verify and complete the findings arrived at by sound.

With the use of automatic equipment, the belling procedure generally is not used in examining the eggs for checks. The candler must be attentive, especially when using machine-flash candling and automatic packaging equipment, so that all checks are removed prior to packaging. Quite often a bubbly air cell in fresh eggs indicates a blind check.

It is necessary to remove leakers and dented checks from the lot carefully to avoid causing further damage to them and to prevent dripping liquid from the leakers onto clean eggs, onto the packaging material, or into the mechanism of the candling equipment. This is necessary for good housekeeping and appearance of the packaged product, and to keep the mechanisms of automatic weighing equipment in proper adjustment.

Shell Cleanliness

In segregating eggs for shell cleanliness the grader should make a preliminary examination of the general appearance of the layer of eggs to be candled at the time the covering flat and surrounding filler are removed. Eggs with only very small specks, stains, or cage marks may be considered clean if such small specks, stains, or cage marks are not of sufficient number or intensity to detract appreciably from the appearance of the eggs (see U.S. Standards for Quality of Individual Shell Eggs). While the eggs are still in standing position (in cup flats) the grader should remove and candle the

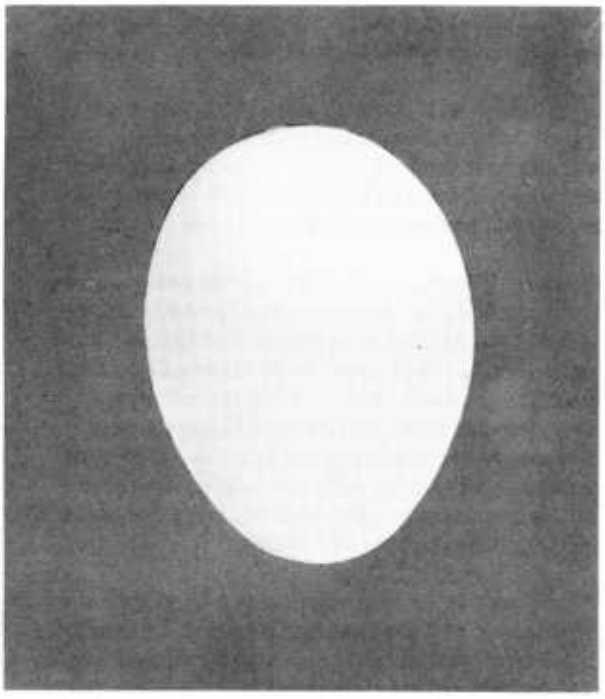

Figure 4.—Ideal egg shape, usually found in AA or A quality. BN-16548

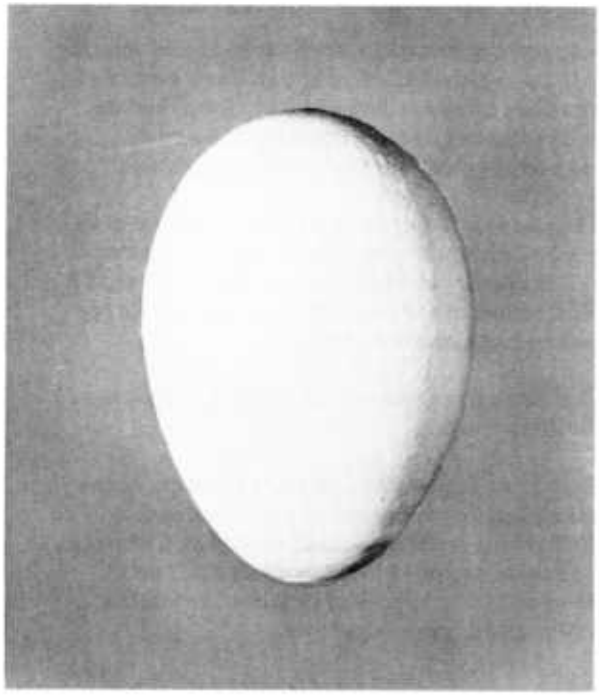

Figure 5.—Practically normal shape which may be found in AA or A quality. BN-16549

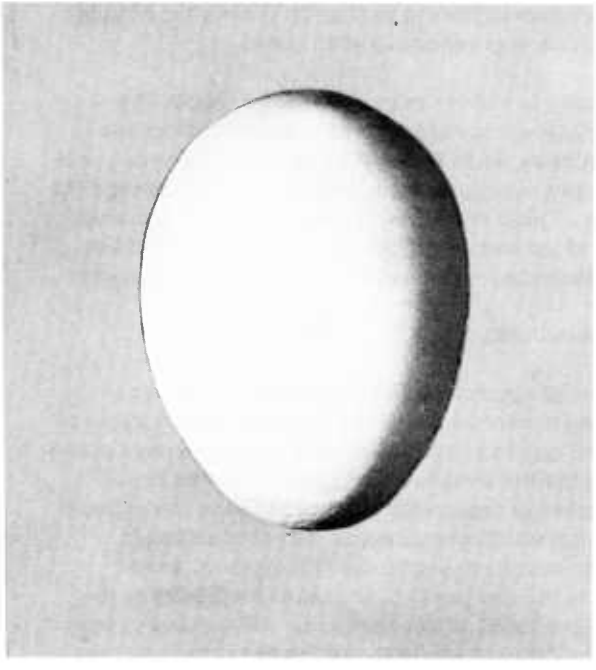

Figure 6.—Practically normal shape, showing slight ridges and rough shell permitted in AA or A quality. BN-16550

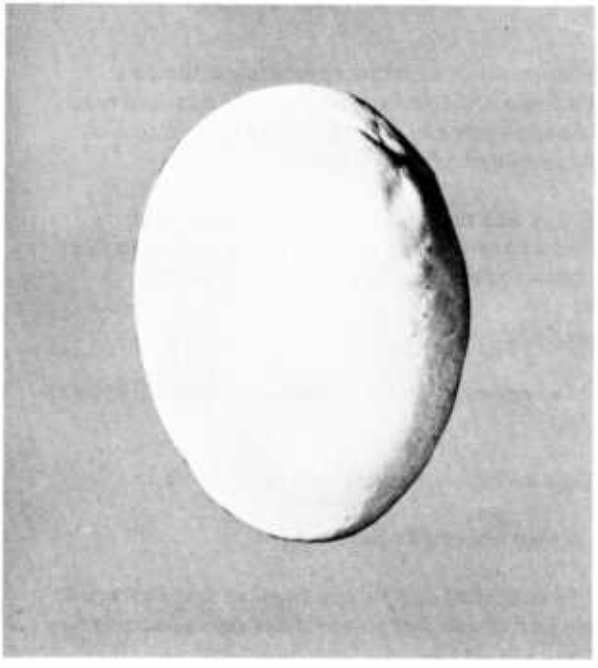

Figure 7.—Abnormal shape having pronounced ridges permitted in B quality. BN-16551

eggs with stained or dirty shells. The remaining eggs that appear clean from a top view should be then gently pushed over on their sides and again the eggs with stained or dirty shells should be removed and candled. These two operations will remove all dirty or stained eggs that are noticed at first glance.

The grader should remove the remaining eggs in the filler, two eggs in each hand, for candling. On the way to the candling aperture, the eggs in each hand should be rotated under the rays of a light that illuminates the contents of the case, commonly referred to as a case light. As the eggs are rotated the grader should observe the shell for stains or dirty conditions.

This operation (rotation and observation for dirt) should be performed rapidly enough that the motion of the hand from the case light to the candling aperture is made in one sweeping motion. Any stained or dirty eggs that are detected at this point should be candled and segregated before the candling of clean eggs is begun. When the eggs are placed before the candling aperture, the grader should remove previously undetected dirty or stained shells. The grader should always have clean, dry hands to avoid staining shells. The candling aperture should be of a material that will not mark or stain the shell and will aid in minimizing breakage.

In machine-flash candling, the examination for cleanliness is most often done immediately following the washing operation, or after the mass scanning for interior quality is made. This operation should be in a well-lighted area, and there should be sufficient lighting directly over the eggs for ease of examination.

Classification of Shell Cleanliness

Freedom from stains and foreign material on the shell must be considered in assigning a quality designation to an individual egg. The following terms are descriptive of shell cleanliness:

Clean. A shell that is free from foreign material and from stains or discolorations that are readily visible. An egg may be considered clean if it has only very small specks, stains, or cage marks, if such specks, stains, or cage marks are not of sufficient number or intensity to detract from the generally clean appearance of the egg. Eggs that show traces of processing oil on the shell are considered clean unless otherwise soiled.

Dirty. A shell that is unbroken and that has dirt or foreign material adhering to its surface, that has prominent stains, or that has moderate stains covering more than one-thirty-second of the shell surface if localized, or one-sixteenth of the shell surface if scattered.

The illustrations in figure 8 are intended as a guide and are not to be used as an actual measurement in grading. Graders should learn to determine the area that constitutes these measurements and then judge eggs having soiled shells against this mental picture.

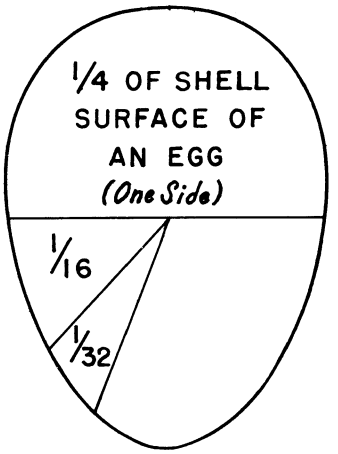

Figure 8.—One thirty-second, one-sixteenth, and one-fourth of shell surface of an egg (areas shown are approximate).

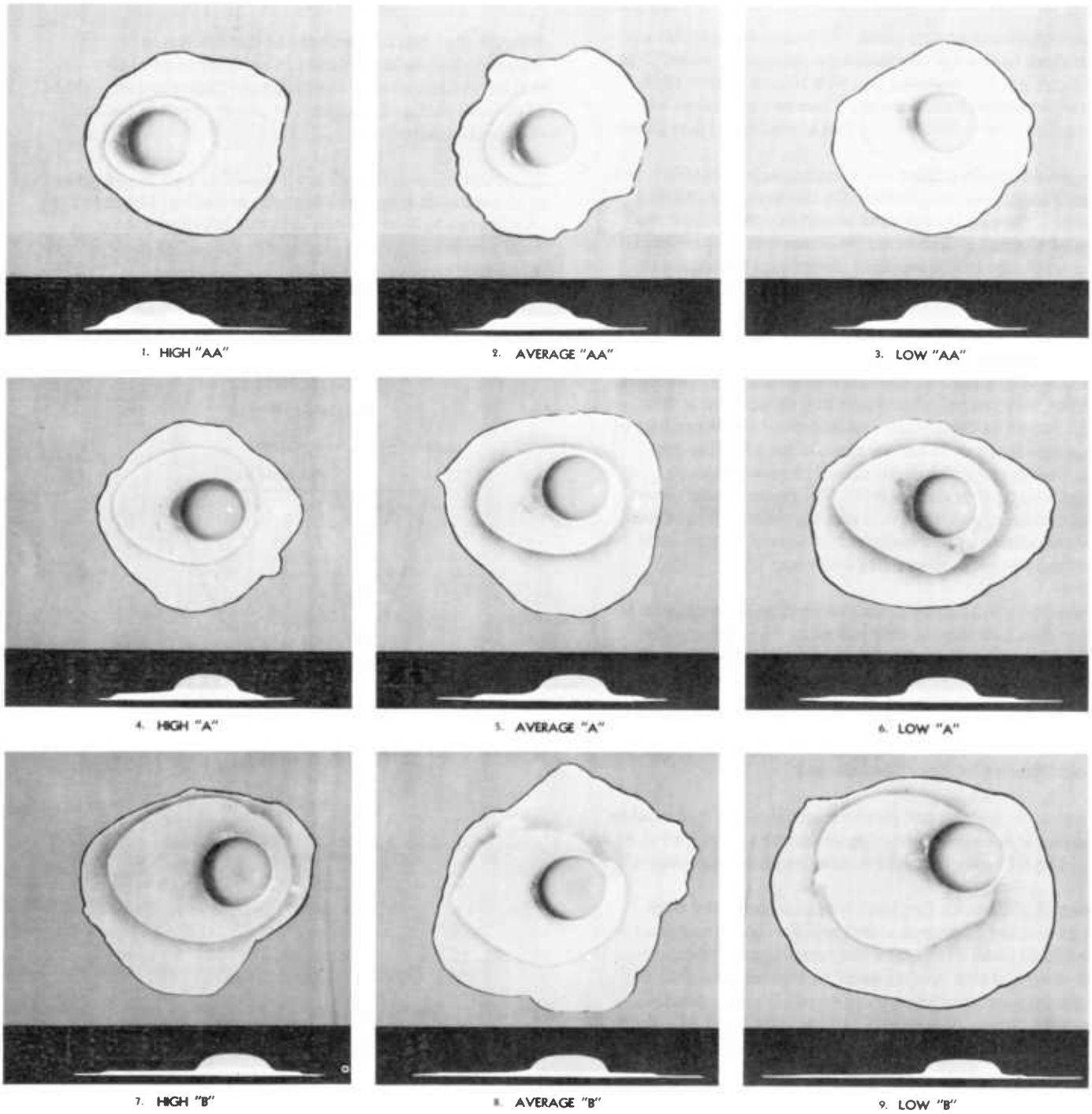

Figure 9.—The pictures on this chart show the interior quality of eggs that meet the specifications of the U.S. Standards for Quality of Individual Shell Eggs with respect to white and yolk quality. Quality factors dealing with the shell, air cell, and defects are not included. Scores 1, 2, and 3 represent the appearance of broken-out eggs of high, average, and low AA quality; 4, 5, and 6 represent high, average, and low A quality; and 7, 8, and 9, high average, and low B quality.

Classification of Interior Quality

Even under the most favorable conditions, egg quality is relatively unstable as the interior quality of the egg deteriorates from the time it is laid until it is consumed. Sometimes quality changes render eggs useless for food before they reach consumers. However, when eggs are properly cared for, the quality decline can be minimized. Quality decline is illustrated graphically in figure 10.

In grading eggs, and more specifically in classifying them according to internal quality, the grader is merely trying to group the eggs according to where each is located on "quality hill."

On the basis of internal quality, edible eggs are divided into three groups as shown in figure 10. All eggs whose candled characteristics fall between the top line and point 1 on the chart are in the highest quality class or AA; those between points 1 and 2 are in the next quality or A; and those between points 2 and 3 are in B quality. Those at and below point X are inedible or loss.

It is relatively easy to place eggs properly if they are midway between the various points on "quality hill," but judgment and skill are required to place in the correct group the eggs that are at or near the quality division points. It becomes increasingly difficult when brown eggs or mixed whites and browns are being candled. The real knack in candling is to have a clear mental picture of the dividing line between the various quality classes, so that the eggs may be properly placed in their respective quality groups.

Good judgment in determining white and yolk condition can be developed and maintained by having graders break out an egg occasionally. Their estimate of the candled quality should be checked with the broken-out appearance as compared with (1) the chart for scoring broken-out appearance (fig. 9) and (2) the Haugh unit (named after its inventor) value of the broken-out egg. This value results from the correlation of the height of the thick white as measured by a micrometer and the weight of the egg. More information about candling eggs and Haugh units is contained further along in this manual.

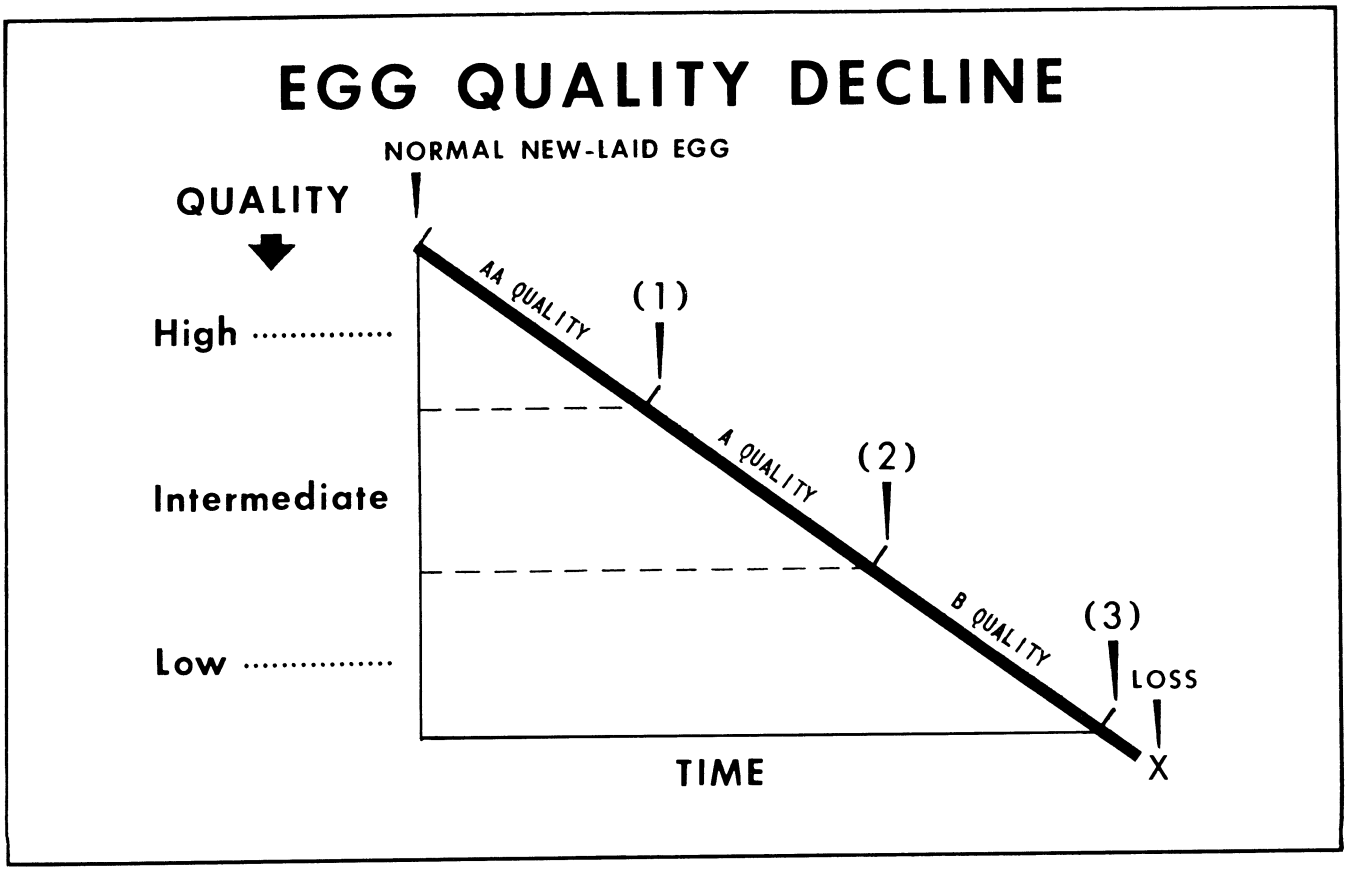

Figure 10.—Range of quality in official grades.

Air Cell

As already stated, when the egg is first laid it has no air cell at all or only a small one. Its temperature is about 105° F. and as the egg cools to room temperature the liquids contract more than does the shell. As the result of this contraction, the inner shell membrane separates from the outer to form the air space.

Further increase in the size of the air cell beyond that resulting from contraction is due to evaporation of water from the egg. The rapidity with which this takes place is due to many factors, such as age, shell texture, temperature, and humidity. The air cell is normally at the large end of the egg and is one of the first factors observed in candling.

The air cell is the easiest quality factor to evaluate, as it can be judged objectively by a simple measuring device — the air-cell gage (fig. 11). In candling, the air cell is considered by many as a relatively unimportant quality factor for determining the broken-out quality of an egg.

However, the air cell is one of the factors of the U.S. standards and, therefore, it can be the determining factor in classifying the individual egg as to quality. Depth is the only quality factor considered with the air cell. Movement is not considered a quality factor, and the air cell may show unlimited movement and be free or bubbly in all qualities (AA, A, B).

The size of the air cells permitted in the various qualities is as follows:

Quality	*Depth*
AA	1/8 inch
A	3/16 inch
B	No limit

The air-cell gage may be used by the beginner learning to judge the size of the air cell accurately at a quick glance while candling. More experienced candlers occasionally use the gage to check the accuracy of their determinations.

The depth of the air cell is measured at the point of greatest distance between the top of the cell and an imaginary plane passing through the egg at the lower edge of the air cell where it touches the shell (fig. 11).

The following terms are descriptive of the air cell:

Depth of air cell — (air space between shell membranes, normally in the large end of the egg) — The depth of the air cell is the distance from its top to its bottom when the egg is held air cell upward.

Free air cell — An air cell that moves freely towards the uppermost part in the egg as the egg is rotated slowly.

Bubbly air cell — A ruptured air cell resulting in one or more small separate air bubbles usually floating beneath the main air cell.

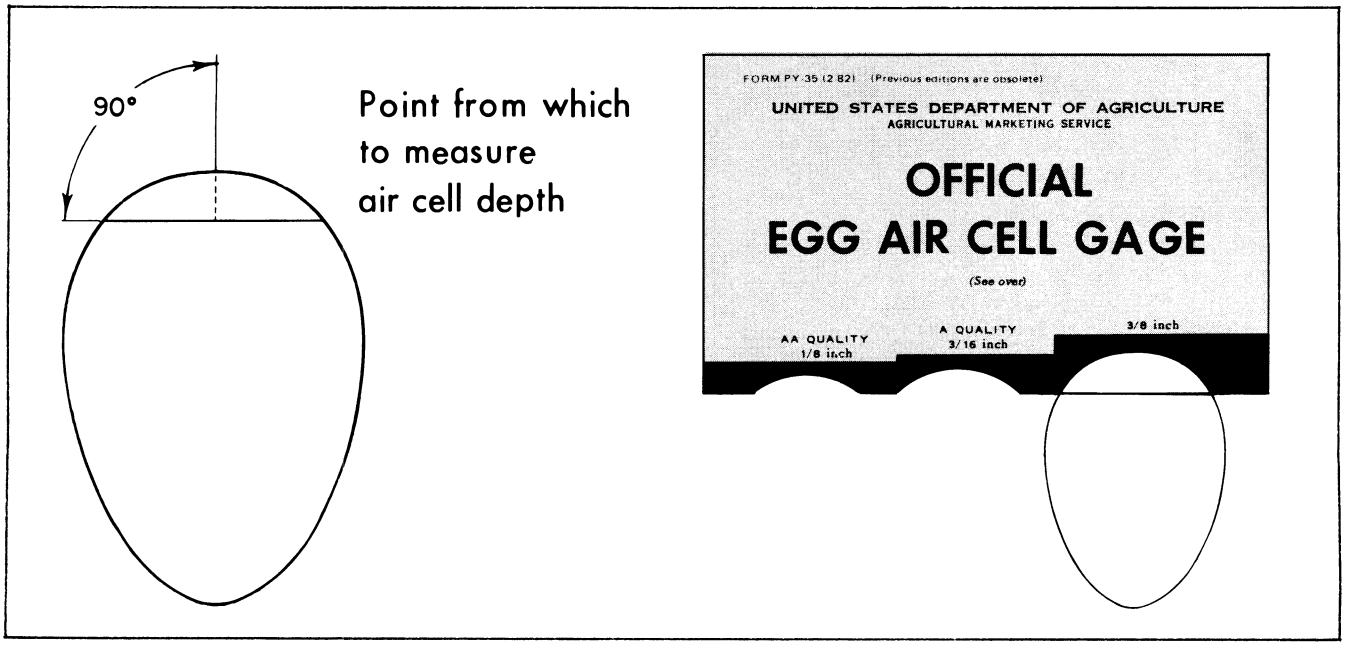

Figure 11.—Measuring depth of air cell.

Yolk

The appearance of the yolk as the egg is twirled in candling is one of the best indicators of the interior quality of shell eggs. The characteristics of the yolk are determined by the shadow that it casts upon the shell before the candling light. The appearance of the yolk is dependent on the condition of the white. However, there are three factors about the yolk itself that are considered in judging egg quality by the yolk. These are:

1. Distinctness of yolk shadow outline.
2. Size and shape of yolk.
3. Defects and germ development.

Distinctness of Yolk Shadow Outline. The distinctness of the yolk outline or shadow outline is governed by three factors:

(1) The thickness and consistency of the white. The thicker the white, the less distinct the outline appears, because the yolk is prevented from moving close to the shell.

(2) Condition of the yolk. This condition is determined by the presence of blemishes that show up before the candling light as dark shadows on the yolk, or the absence of these blemishes; and the presence or absence of an off-colored yolk appearance which shows as a grayish or greenish shadow.

(3) Color of the yolk. It is difficult to determine the color of the yolk before the candling light except off-color. However, extremes in yolk color may influence the candler's judgment of the egg quality. An extremely deep-colored yolk, under some conditions, would cast a darker shadow before the candling light than would a lighter yolk.

By concentrating on the yolk outline instead of the depth of the yolk shadow, therefore, the grader will minimize the influence of yolk color on quality determinations. The color of the yolk and the firmness of the white are two interacting influences affecting the distinctness of the yolk shadow outline; therefore, a grader cannot be reasonably certain which is the more important factor in any specific case.

The principle of judging distinctness of the outline rather than the depth of darkness of the shadow can be illustrated by holding a ball close to a wall so its shadow falls on the wall, and then holding it a little farther away from the wall. At the greater distance, the outline of the shadow is less distinct.

The terms used to define the three degrees of distinctness of yolk shadow outline in the U.S. standards of quality for shell eggs are:

Outline slightly defined — A yolk outline that is indistinctly indicated and appears to blend into the surrounding white as the egg is twirled. (AA quality).

Outline fairly well defined — A yolk outline that is discernible but not clearly outlined as the egg is twirled. (A quality).

Outline plainly visible — A yolk outline that is clearly visible as a dark shadow when the egg is twirled. (B quality).

Size and Shape of Yolk. The yolk in a new-laid egg is round and firm. As the yolk ages it absorbs water from the white. This increases its size and causes it to stretch and weaken the vitelline membrane and to assume a somewhat flattened shape on top and an "out-of-round" shape generally, resembling a balloon partially filled with water. Yolk size and shape are mentioned only in the lowest quality classification for eggs — B quality — where these factors become apparent. The terms used in the U.S. Standards of Quality for Shell Eggs to describe yolk size and shape are:

Enlarged and flattened — A yolk in which the yolk membranes and tissues have weakened and/or moisture has been absorbed from the white to such an extent that the yolk appears definitely enlarged and flat. (B quality).

Defects and Germ Development — Relatively little is known about the exact causes of most yolk defects other than those due to germ development. Some of the causes which have been advanced are: irregular deposits of light and dark yolk; blemishes from rubbing; and development of accumulations or clusters of the fat and oil in droplets. The relative viscosity of the white has a direct bearing on the accurate determination of defects on the yolk before the candling light. Unless yolk defects are very prominent, detection of them is difficult, particularly when the egg has a thick white. Germ development is visible before the candling light and can generally be detected as a circular dark area near the center of the yolk shadow. If blood is visible, the egg must be rejected as inedible.

The terms used to describe yolk defects are:

Practically free from defects — A yolk that shows no germ development but may show other very slight defects on its surface. (AA and A quality)

Serious defects — A yolk that shows well developed spots or areas and other serious defects, such as olive yolks, that do not render the egg inedible. (B quality).

Clearly visible germ development — Development of the germ spot on the yolk of a fertile egg that has progressed to the point where it is plainly visible as a definite circular area or spot with no blood in evidence. (B quality)

Blood due to germ development — Blood caused by development of the germ in a fertile egg to a point where it is visible as definite lines or as a blood ring. Such as egg is classified as inedible.

White

Nearly all new-laid eggs contain four layers of white—chalaziferous, inner thin, thick, and outer thin. The appearance of the egg before the candling light is governed largely by the relative proportions of the thick and outer thin layers of white. The white and yolk are very closely associated and any discussion of either factor, of necessity, involves the other. However, there are two important considerations about the white which are included in standards of quality: condition or viscosity and clarity.

The condition of the white is determined in candling by the intensity of the yolk shadow and the freedom of movement of the yolk as the egg is twirled before the candling light. These factors are related to the viscosity of the white. Thick whites permit only limited movement of the yolk and an indistinct shadow results.

The reverse is true of thin whites which permit free movement of the yolk and a distinct shadow results. The grader must judge from the behavior of the yolk, how the white will appear when the egg is broken out. Figure 9 shows the appearance of the white in broken-out eggs.

The following terms describe the white:

Clear — A white that is free from discolorations or from any foreign bodies floating in it. Prominent chalazas should not be confused with foreign bodies such as spots or blood clots. (AA, A quality)

Firm — A white that is sufficiently thick or viscous to prevent the yolk outline from being more than slightly defined or indistinctly indicated when the egg is twirled. With respect to a broken-out egg, a firm white has a Haugh unit value of 72 or higher when measured at a temperature between 45° and 60° F. (AA quality).

Reasonably firm — A white that is somewhat less thick or viscous than a firm white. A reasonably firm white permits the yolk to approach the shell more closely, which results in a fairly well defined yolk outline when the egg is twirled. With respect to a broken-out egg, a reasonably firm white has a Haugh unit value of 60 to 72 when measured at a temperature between 45° and 60° F. (A quality).

Weak and watery — A white that is weak, thin, and generally lacking in viscosity. A weak and watery white permits the yolk to approach the shell closely, thus causing the yolk outline to appear plainly visible and dark when the egg is twirled. With respect to a broken-out egg, a weak and watery white has a Haugh unit value lower than 60 when measured at a temperature between 45° and 60° F. (B quality)

Blood spots or meat spots — Small blood spots or meat spots (aggregating not more than one-eighth inch in diameter) may be classified as B quality. If larger, or showing diffusion of blood into the white surrounding a blood spot, the egg shall be classified as loss. Blood spots shall not be due to germ development. They may be on the yolk or in the white. Meat spots may be blood spots which have lost their characteristic red color or tissue from the reproductive organs.

Bloody white — An egg which has blood diffused through the white. Such a condition may be present in new-laid eggs. Eggs with bloody whites are classed as loss.

Loss Eggs

The U.S. standards of quality also define certain eggs as "loss."

Loss — An egg that is inedible, leaker, cooked, frozen, contaminated, or containing bloody whites, large blood spots, large unsightly meat spots, or other foreign material.

Inedible eggs — Inedible eggs are described in the U.S. standards to include black rots, white rots, sour eggs, eggs with green whites, musty eggs, and moldy eggs. These types of inedible eggs are usually caused by the growth of bacteria or mold on or in the egg. Other types of inedible eggs are those showing blood rings, and those containing embryo chicks (at or beyond the blood ring stage) which result from germ development in fertile eggs. Two additional types of inedible eggs are mixed rots and eggs with stuck yolks.

The freshly laid egg is usually free of bacteria on the inside and is well protected from bacteria by the shell, shell membranes, and several chemical substances in the egg white. If subjected to warm temperatures or moisture, or both, bacteria are able to penetrate the egg and overcome the egg's defense. When bacteria grow inside the egg they may form byproducts or cause the contents of the egg to decompose, or both. These conditions result in the characteristic colors, appearance, or odors from which the rots take their name.

Stuck yolk occurs when the yolk membrane becomes attached to the shell membrane. It generally occurs in older eggs that have been left in a fixed position for a long time. When the thick white becomes thin, the yolk floats close to the shell and becomes attached to the shell membrane.

Before the candling light the yolk appears attached to the shell and snaps back to its attached position when the twirling motion of the egg is stopped. If loosened from its position, the yolk membrane usually breaks, permitting the yolk content to seep into the white. The first stage of this condition is generally referred to as "seeping yolk"; later "mixed rot" or "addled egg."

Mixed rot (addled egg) occurs when the vitelline membrane of the yolk breaks and the yolk mixes with the white, resulting in a murkiness throughout the interior of the egg when viewed before the candling light.

Sour egg is often difficult to detect by standard candling methods. Generally, eggs in this condition show a weak white and murky shadow around an off-center swollen yolk. The bacteria, causing sour eggs, belong to a group named *Pseudomonas.* These organisms produce a material which fluoresces under ultraviolet light, giving off a green sheen. The adoption of ultraviolet light in candling (black light) has made the detection of this type of loss easier.

Eggs with *green whites* can be detected by experienced graders using the standard candling light. This type of loss is caused by the *Pseudomonas* group of bacteria. Like sour eggs, eggs with green whites will fluoresce under the ultraviolet light when broken out. Eggs with green whites may or may not have a sour odor.

In early stages the *white rot* may be detected by the presence of threadlike shadows in the thin white. In later stages the yolk appears severely blemished when viewed before the candling light, and when broken shows a crusted appearance. The content frequently gives off a fruity odor. This is classified as a "mixed rot."

Musty eggs frequently appear clear and free from foreign material when viewed before the candling light and can generally be detected only by the characteristic musty odor emanating from the egg. Sources of contamination may be a musty odor in the case or the nesting material, or the presence of this odor on the shell itself.

It is said that certain bacteria that occasionally invade the egg give off this characteristic odor also. Because this type of loss is impossible to detect by visual observation, it is important that the grader note the odor emanating from the case and packing material immediately upon opening the case.

Moldy eggs may be detected by observing mold spots on the shell or by mold growth in checked areas of the shell, or by mold growths (the odor of mold or must may or may not be present) inside the egg itself when viewed before the candling light. The use of dirty water for washing eggs and dirty processing oil cooler than the egg, and the storage of the egg in unusually high humidity encourage mold growth and mold penetration through the shell. Advanced stages of mold growth throughout the entire egg might have an appearance similar to that of black rot.

Black rots are generally opaque (with the exception of the air cell) when viewed before the candling light. When broken the contents have a muddy brown appearance and give off a repulsive, putrid odor. The bacteria most frequently causing this type of loss belong to a group named *Proteus.* However, when any rot is at an advanced stage, it may appear "black" before the candling light.

Cooked eggs are eggs which have been subjected to heat resulting in coagulation of the contents. Cooked eggs, when held before the candling light may be identified by the presence of threadlike shadows in the white indicating a slightly cooked egg, or a dark, opaque appearance indicating complete coagulation of the contents.

Blood rings and embryo chicks are caused by germ development, occurring in fertile eggs held at incubation temperatures. At a rather early stage in incubation (after 24 hours) the embryo develops a circulatory system. If at this stage the embroy dies the blood drains to the outer edge of the germ disc, causing the blood ring. Before the candling light, it appears as a brilliant blood-red circle from one-eighth to three-eighths inch in diameter, depending on the stage of development.

If incubation temperatures are maintained for a longer period, the embryo chick is formed by about the third day and eventually fills most of the egg. This can be observed before the candling light as an actual outline of the embryo, in the early stages.

In addition to the inedible eggs described above, eggs showing severe shell damage and the presence of large blood spots or diffused blood in the white, are classified as loss. Leakers are classified as loss.

The origin of *large blood spots and bloody whites* has already been explained. They appear as brilliant red in color or as a dark gray in so-called meat spots, in contrast to the surrounding lemon-to-orange colored tinge of the yolk, observed before the candling light.

Eggs not classified as loss but as "no grade" include eggs of possible edible qualities that have been contaminated by smoke, chemicals, or other foreign material which has seriously affected the character, appearance, or flavor of the eggs.

High concentrations of fish oil or garlic fed to hens impart their flavor to the eggs. Eggs exposed to foreign odors after they have been laid may give off these odors. Eggs stored near kerosene, carbolic acid, mold, must, fruits, and vegetables, for example, readily absorb odors from these products.

U.S. Standards, Grades, and Weight Classes for Shell Eggs

The U.S. standards, grades, and weight classes for individual shell eggs are applicable only to eggs of the domesticated chicken that are in the shell.

U.S. Standards for Quality of Individual Shell Eggs

(Based on Candled Appearance)

The standards described below are summarized in table 2.

AA quality — The shell must be clean, unbroken, and practically normal. The air cell must not exceed one-eighth inch in depth, may show unlimited movement, and may be free or bubbly. The white must be clear and firm so that the yolk is only slightly defined when the egg is twirled before the candling light. The yolk must be practically free from apparent defects.

A quality — The shell must be clean, unbroken, and practically normal. The air cell must not exceed three-sixteenths inch in depth, may show unlimited movement, and may be free or

Table 2. — Summary of U.S. Standards for quality of individual shell eggs

	Specifications for each quality factor		
Quality Factor	**AA Quality**	**A Quality**	**B Quality**
Shell	Clean. Unbroken. Practically normal.	Clean. Unbroken. Practically normal.	Clean to slightly stained.* Unbroken. Abnormal.
Air Cell	1/8 inch or less in depth. Unlimited movement and free or bubbly.	3/16 inch or less in depth. Unlimited movement and free or bubbly.	Over 3/16 inch in depth. Unlimited movement and free or bubbly.
White	Clear. Firm.	Clear. Reasonably firm.	Weak and watery. Small blood and meat spots present.**
Yolk	Outline——slightly defined. Practically free from defects.	Outline——fairly well defined. Practically free from defects.	Outline——plainly visible. Enlarged and flattened. Clearly visible germ development but no blood. Other serious defects.

*Moderately stained areas permitted (1/32 of surface if localized, or 1/16 if scattered).
**If they are small (aggregating not more than 1/8 inch in diameter).

For eggs with dirty or broken shells, the standards of quality provide two additional qualities. These are:

Dirty	Check
Unbroken. Adhering dirt or foreign material, prominent stains, moderate stained areas in excess of B quality.	Broken or cracked shell but membranes intact, not leaking.***

*** Leaker has broken or cracked shell and membranes, and contents leaking or free to leak.

bubbly. The white must be clear and at least reasonably firm so that the yolk outline is only fairly well defined when the egg is twirled before the candling light. The yolk must be practically free from apparent defects.

B quality — The shell must be unbroken, may be abnormal, and may have slightly stained areas. Moderately stained areas are permitted if they do not cover more than one-thirty-second of the shell surface if localized , or one-sixteenth of the shell surface if scattered. Eggs having shells with prominent stains or adhering dirt are not permitted. The air cell may be over three-sixteenths inch in depth, may show unlimited movement, and may be free or bubbly. The white may be weak and watery so that the yolk outline is plainly visible when the egg is twirled before the candling light. The yolk may appear dark, enlarged, and flattened, and may show clearly visible germ development but no blood due to such development. It may show other serious defects that do not render the egg inedible. Small blood spots or meat spots (aggregating not more than one-eighth inch in diameter) may be present.

Dirty — An individual egg that has an unbroken shell with adhering dirt or foreign material, prominent stains, or moderate stains covering more than one-thirty-second of the shell surface if localized, or one-sixteenth of the shell surface if scattered.

Check — An individual egg that has a broken shell or crack in the shell but its shell membranes are intact and its contents do not leak.

Leaker — An individual egg that has a crack or break in the shell and shell membranes to the extent that the egg contents are exuding or free to exude through the shell.

NOTE: The C quality classification for individual shell eggs was eliminated in 1981. The percentage of C quality eggs found in the total egg production had decreased to an insignificant point—about 1 percent of nest run eggs.

U.S. Consumer Grades and Weight Classes for Shell Eggs

The grading regulations for shell eggs provide for "origin" and "destination" consumer grades. "Origin grading" is defined as a grading made on a lot of eggs at a plant where the eggs are graded and packed.

Table 3 gives a summary of the consumer grades, while table 4 gives the tolerance for individual cases within a lot.

U.S. consumer grade AA (at origin) shall consist of eggs that are at least 87 percent AA quality. The maximum tolerance of 13 percent that may be below AA quality may consist of A or B quality in any combination, except that within the tolerance for B quality not more than 1 percent may be B quality due to air cells over three-eighths inch, blood spots (aggregating not more than one-eighth inch in diameter), or serious yolk defects. Not more than 5 percent (7 percent for Jumbo size) checks are permitted and not more than 0.50 percent leakers, dirties, or loss (due to meat or blood spots) in any combination, except that such loss may not exceed 0.30 percent. Other types of loss are not permitted.

U.S. consumer grade AA (destination) shall consist of eggs that are at least 72 percent AA quality. The remaining tolerance of 28 percent shall consist of at least 10 percent A quality and the remainder shall be B quality, except that within the tolerance for B quality not more than 1 percent may be B quality due to air cells over three-eighths inch, blood spots (aggregating not more than one-eighth inch in diameter), or serious yolk defects. Not more than 7 percent (9 percent for Jumbo size) checks are permitted and not more than 1 percent leakers, dirties, or loss (due to meat or blood spots) in any combination, except that such loss may not exceed 0.30 percent. Other types of loss are not permitted.

U.S. consumer grade A (at origin) shall consist of eggs that are at least 87 percent A quality or better. Within the maximum tolerance of 13 percent that may be below A quality, not more than 1 percent may be B quality due to air cells over three-eighths inch, blood spots (aggregating not more than one-eighth inch in diameter), or serious yolk defects. Not more than 5 percent (7 percent for Jumbo size) checks are permitted and not more than 0.50 percent leakers, dirties, or loss (due to meat or blood spots) in any combination, except that such loss may not exceed 0.30 percent. Other types of loss are not permitted.

U.S. consumer grade A (destination) shall consist of eggs that are at least 82 percent A quality or better. Within the maximum tolerance of 18 percent that may be below A quality, not more than 1 percent may be B quality due to air cells over three-eighths inch, blood spots (aggregating not more than one-eighth inch in diameter), or serious yolk defects. Not more than 7 percent (9 percent for Jumbo size) checks are permitted and not more than 1 percent leakers, dirties, or loss (due to meat or blood spots) in any combination, except that such loss may not exceed 0.30 percent. Other types of loss are not permitted.

U.S. consumer grade B (at origin) shall consist of eggs that are at least 90 percent B quality or better, not more than 10 percent may be checks and not more than 0.50 percent leakers, dirties, or loss (due to meat or blood spots) in any combination, except that such loss may not exceed 0.30 percent. Other types of loss are not permitted.

U.S. consumer grade B (destination) shall consist of eggs that are at least 90 percent B quality or better, not more than 10 percent may be checks and not more than 1 percent leakers, dirties, or loss (due to meat or blood spots) in any combination, except that such loss may not exceed 0.30 percent. Other types of loss are not permitted.

Additional tolerances — In lots of two or more cases:

For grade AA — No individual case may exceed 10 percent less AA quality eggs than the minimum permitted for the lot average.

For grade A — No individual case may exceed 10 percent less A quality eggs than the minimum permitted for the lot average.

For grade B — No individual case may exceed 10 percent less B quality eggs than the minimum permitted for the lot average.

For grades AA, A, and B, no lot shall be rejected or downgraded due to the quality of a single egg except for loss other than blood or meat spots.

NOTE: The fresh fancy quality control program was eliminated in 1981 because it was used very little. The grade A quality control program was also eliminated then because it was not being used.

Weight Classes

The weight classes for U.S. consumer grades for shell eggs shall be as indicated in table 5 and shall apply to all consumer grades.

A lot-average tolerance of 3.3 percent for individual eggs in the next lower weight class is permitted as long as no individual case within the lot exceeds 5 percent.

Table 3.—Summary of U.S. consumer grades for shell eggs

U.S. consumer grade (origin)	Quality required[1]	Tolerance permitted[2] Percent	Quality
Grade AA	87 percent AA	Up to 13	A or B[5]
		Not over 5	Checks[6]
Grade A	87 percent A or better	Up to 13	B[5]
		Not over 5	Checks[6]
Grade B	90 percent B or better	Not over 10	Checks

U.S. consumer grade (destination)	Quality required[1]	Tolerance permitted[3] Percent	Quality
Grade AA	72 percent AA	Up to 28[4]	A or B[5]
		Not over 7	Checks[6]
Grade A	82 percent A or better	Up to 18	B[5]
		Not over 7	Checks[6]
Grade B	90 percent B or better	Not over 10	Checks

[1]In lots of two or more cases, see table 4 of this section for tolerances for an individual case within a lot.

[2]For the U.S. Consumer grades (at origin), a tolerance of 0.50 percent leakers, dirties, or loss (due to meat or blood spots) in any combination is permitted, except that such loss may not exceed 0.30 percent. Other types of loss are not permitted.

[3]For the U.S. Consumer grades (destination), a tolerance of 1 percent leakers, dirties, or loss (due to meat or blood spots) in any combination is permitted, except that such loss may not exceed 0.30 percent. Other types of loss are not permitted.

[4]For U.S. Grade AA at destination, at least 10 percent must be A quality or better.

[5]For U.S. Grade AA and A at origin and destination within the tolerances permitted for B quality, not more than 1 percent may be B quality due to air cells over 3/8 inch, blood spots (aggregating not more than 1/8 inch in diameter), or serious yolk defects.

[6]For U.S. Grades AA and A Jumbo size eggs, the tolerance for checks at origin and destination is 7 percent and 9 percent, respectively.

Table 4.—Tolerance for individual case within a lot

U.S. consumer grade	Case quality	Origin	Destination
		Percent	
Grade AA	AA (min)	77	62
	A or B	13	28
	Check (max)	10	10
Grade A	A (min)	77	72
	B	13	18
	Check (max)	10	10
Grade B	B (min)	80	80
	Check (max)	20	20

Table 5.—Weight classes of U.S. consumer grades for shell eggs

Size or weight class	Minimum net weight per dozen	Minimum net weight per 30 dozen	Minimum weight for individual eggs at rate per dozen
	Ounces	*Pounds*	*Ounces*
Jumbo	30	56	29
Extra large	27	50-1/2	26
Large	24	45	23
Medium	21	39-1/2	20
Small	18	34	17
Peewee	15	28	—

U.S. Wholesale Grades and Weight Classes for Shell Eggs

Table 6 gives a summary of the wholesale grades listed below.

U.S. Specials— % AA quality shall consist of eggs of which at least 20 percent are AA quality; and the actual percentage of AA quality eggs shall be stated in the grade name. Within the maximum of 80 percent that may be below AA quality, not more than 7.5 percent may be B quality, dirties, or checks in any combination and not more than 2.0 percent may be loss.

U.S. Extras— % A quality shall consist of eggs of which at least 20 percent are not less than A quality; and the actual total percentage of A quality and better shall be stated in the grade name. Within the maximum of 80 percent that may be below A quality, not more than 11.7 percent may be dirties or checks in any combination, and not more than 3.0 percent may be loss.

U.S. Standards— % B quality shall consist of eggs of which at least 84.3 percent are B quality; and the actual total percentage of B quality and better shall be stated in the grade name. Within the maximum of 15.7 percent that may be below B quality, not more than 11.7 percent may be dirties or checks in any combination and not more than 4.0 percent may be loss.

NOTE: Three wholesale grades — "U.S. Trades," "U.S. Dirties," and "U.S. Checks" were eliminated in 1981 since they had not been used for years.

Weight Classes

The weight classes for the U.S. wholesale grades for shell eggs shall be as indicated in table 7.

Table 6.—Summary of U.S. wholesale grades for shell eggs

Wholesale grade designation	Minimum percentage of eggs of specific qualities required[1]			Maximum tolerance permitted (lot average)		
	AA quality	A quality or better	B quality or better	B quality dirties and checks	Dirties and checks	Loss
				----	*Percent*	----
U.S. Specials—% AA Quality[2]	20	Balance	None except for tolerance	7.5	—	2
U.S. Extras—% A Quality[2]	—	20	Balance	—	11.7	3
U.S. Standards—% B Quality[2]	—	—	84.3	—	11.7	4

[1]Substitution of eggs possessing higher qualities for those possessing lower specified qualities is permitted.
[2]The actual total percentage must be stated in the grade name.

Table 7.—Weight classes for U.S. wholesale grades for shell eggs

Weight classes	For 30 dozen eggs		Weights for individual eggs at rate per dozen	
	Average net weight on a lot[1] basis	Minimum net weight individual case[2] basis	Minimum weight	Weight variation tolerance for not more than 10 percent, by count, of individual eggs
	At least—			
Extra large	50-1/2 pounds	50 pounds	26 ounces	Under 26 but not under 24 ounces
Large	45 pounds	44 pounds	23 ounces	Under 23 but not under 21 ounces
Medium	39-1/2 pounds	39 pounds	20 ounces	Under 20 but not under 18 ounces
Small	34 pounds	None	None	None

[1]Lot means any quantity of 30 dozen or more eggs.
[2]Case means standard 30 dozen egg case as used in commercial practice in the U.S.

Table 8.—Summary of U.S. nest run grade for shell eggs

Nest Run grade description[2]	Minimum percentage of quality required (lot average)[1]		Maximum percentage tolerance permitted (15% lot average)[1]			
	AA Quality[3]	A Quality or better[4]	B Quality for shell shape, interior quality (including blood and meat spots), or cage marks[5] and blood stains	Checks	Loss	Adhering dirt or foreign material 1/2 inch or larger in diameter
U.S. Nest Run ___ % AA Quality[6]	20	85	10	6	3	5

[1]Substitution of eggs of higher qualities for lower specified qualities is permitted.
[2]Stains (other than rusty or blackish appearing cage marks or blood stains), and adhering dirt and foreign material on the shell less than 1/2 inch in diameter shall not be considered as quality factors in determining the grade designation.
[3]No case may contain less than 10 percent AA quality.
[4]No case may contain less than 75 percent A quality and AA quality eggs in any combination.
[5]Cage marks which are rusty or blackish in appearance shall be considered as quality factors. Marks which are slightly gray in appearance are not considered as quality factors.
[6]The actual total percentage must be stated in the grade name.

U.S. Nest Run Grade and Weight Classes for Shell Eggs

Table 8 summarizes the nest run grade described below.

U.S. Nest Run—% AA quality shall consist of eggs of current production of which at least 20 percent are AA quality; and the actual percentage of AA quality eggs shall be stated in the grade name. Within the maximum of 15 percent that may be below A quality, not more than 10 percent may be B quality for shell shape, for interior quality (including meat or blood spots), or due to rusty or blackish-appearing cage marks or blood stains; not more than 5 percent may have adhering dirt or foreign material on the shell one-half inch or larger in diameter; not more than 6 percent may be checks; and not more than 3 percent may be loss. Marks that are slightly gray in appearance and adhering dirt or foreign material on the shell less than one-half inch in diameter are not considered quality factors. The eggs shall be officially graded for all other quality factors. No case may contain less than 75 percent A quality and AA quality eggs in any combination.

The weight classes for the U.S. nest run grade for shell eggs shall be as indicated in table 9.

Table 9.—Weight classes for U.S. nest run grade for shell eggs

Weight classes	Minimum average net weight on lot basis 30-dozen cases
	Pounds
Class XL	51
Class 1	48
Class 2	45
Class 3	42
Class 4	39

No individual sample case may vary more than 2 pounds (plus or minus) from the lot average.

U.S. Procurement Grades and Weight Classes for Shell Eggs

NOTE: U.S. procurement grades and weight classes for shell eggs were eliminated in 1981 since they were obsolete. Procurement grade II had not been used for a number of years. Procurement grade I was practically identical to U.S. consumer grade A; thus, the consumer grade standard could readily be used in place of the procurement standard. The U.S. Department of Defense was the principal user of procurement grade I.

Determining Interior Quality by Hand Candling

Hand candling is used very little in present commercial grading operations. Automated equipment and mass scanning devices have practically replaced these manual operations. However, hand candling is still an excellent method for teaching and demonstrating quality determination and is used for spot checking and determining accuracy in grading.

Hand Candling Booth

For purposes of quality control, there should be at least one or preferably several strategically located candling booths in each grading plant. Ideally, the booth should be 6 feet wide, 4 feet deep, and 7 feet high. The proper type of candling booth and equipment needed for check grading or quality control are illustrated in figure 12.

Hand Candling Light

There are many styles and types of candling lights commercially available in which the light intensity and the size of the candling light opening vary considerably. Most of these lights are satisfactory if they are adjusted to provide comfort and proper illumination for the job. It is largely a matter of becoming accustomed to the type of light in use. The accuracy of the candling results can be checked by breaking out an occasional egg and comparing the broken-out quality with the quality determined by candling.

If a lens and a reflector are used, they should be freed periodically of the film-like coating. The reflector should be kept in adjustment and the silver surface should be intact.

Graders may adjust their quality interpretation slightly according to different types of candling lights or varied adjustments of the same light. In selecting a candling light, therefore, it is best to select one type of light and keep it clean and properly adjusted. Once a grader has adjusted candled interpretation to a reasonably close correlation with the broken-out appearance of eggs, uniform grading can be maintained with moderate supervision.

The opening that the egg is held up to for examination should be no larger than 1-1/8 inches in diameter. The opening at the bottom of the light should be no larger than necessary to provide sufficient illumination to detect dirty eggs and to observe the condition of the packing material. The light should be adjusted so that its aperture is approximately on the level of the grader's elbows. The interior of the candling light should be kept clean and free from dust to assure maximum light efficiency.

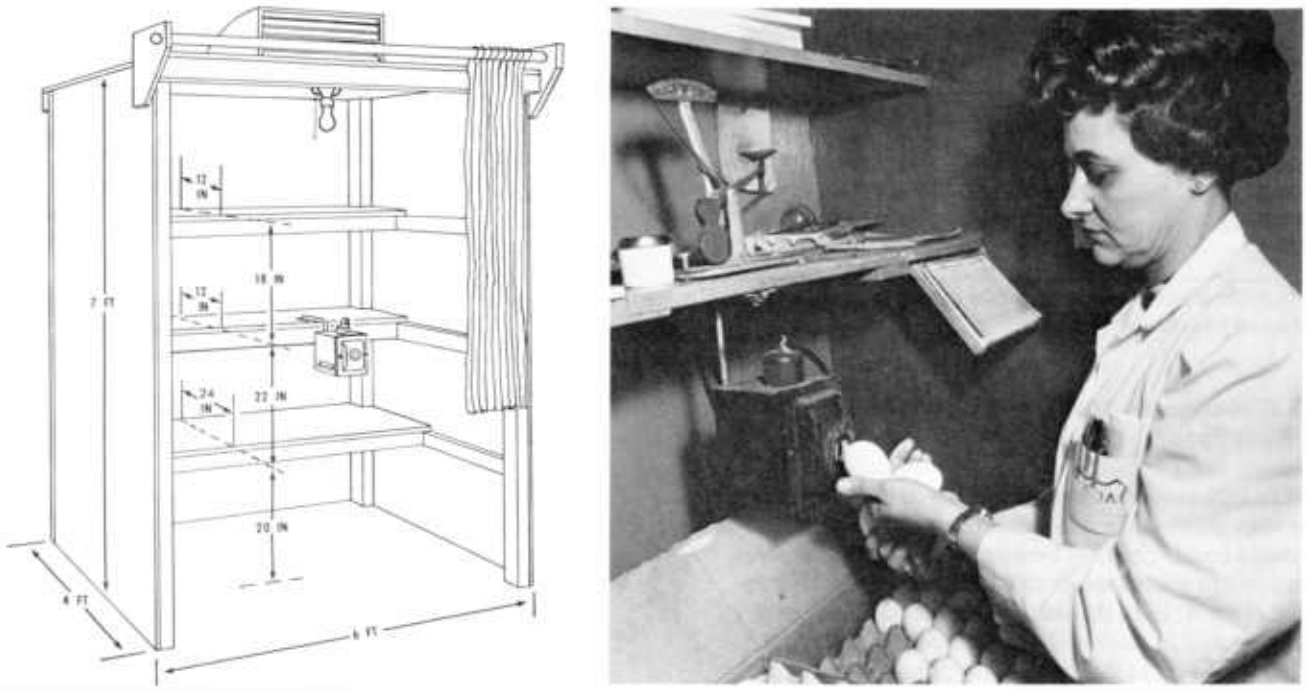

Figure 12.—Dimensions and layout of an ideal candling booth are illustrated at left. Pictured at right is operational candling booth and needed equipment. 0272B178-32

Hand Candling Technique

In determining interior quality by hand candling it is customary to hold two eggs in each hand, supporting one egg by the tips of the thumb and index finger and holding the other against the palm with the other fingers. The small ends of the eggs should point toward the palm of the hand (fig. 13). After one egg in the hand has been candled, it is shifted back in a rotating motion to the palm of the hand and the second egg is brought into candling position. The eggs are viewed alternately before the light.

The uppermost egg in one hand is examined first, then the uppermost egg in the other hand, and this procedure is repeated after the position of the eggs in each hand has been shifted. After the first egg is candled and the hand is dropped slightly back and downward, the third and fourth fingers are relaxed, letting the uncandled egg roll downward slightly.

At the same time the thumb and index and second fingers guide the candled egg into the palm of the hand. The third and little fingers then roll the uncandled egg into candling position between the thumb and index finger; meanwhile the little finger (fourth) and third finger hold the candled egg in the palm. The position of the egg is changed in one hand while one of the eggs held in the other hand is being candled.

The ability to quickly rotate two eggs in each hand makes for more rapid work and should be practiced until reasonable dexterity is acquired. In manipulating eggs before the candling light, it is important that the rotation of eggs in each hand and the twirling motion before the light become mechanical.

Dexterity in this rotation operation permits the grader to concentrate entirely on placing the egg before the light rather than on changing its position, on rotating the two eggs, or on concern over dropping the eggs. It also helps the grader develop a rhythm which improves uniform timing of judgment, thereby making possible greater proficiency.

Figure 13.—The way to hold eggs while candling. BN-31367

In order to obtain a proper view of the egg while candling, it is necessary to have the contents spinning within the shell at the time of viewing. This can be achieved in one smooth motion when the two eggs in the one hand are being rotated and moved toward the aperture in the candling light. The contents of the egg will be set in motion by a movement of hand and wrist in an arc of about 180°.

Stopping the hand motion at the end of the arc without moving the arm or body permits the contents to spin within the shell. The long axis of the egg should be at about a 45° angle to the candling aperture. The thumb and index finger should be on opposite sides of the shell without obstructing the grader's view (fig. 13). After gaining some experience in the candling operation, the grader will learn to have the egg content spinning at the exact instant the egg is placed before the candling aperture.

Determining Interior Quality by the Breakout Method

The breakout method of determining interior quality is a way for students to fine-tune their grading skills. It enables them to make comparisons of broken-out egg appearance with candled appearance. At one time this method was part of USDA's quality control program.

Quality Control Program

Research workers and breeders experimented for years on a more objective way of determining interior quality based on the measurement of the height of the thick white correlated with the weight of the egg. Statistical analysis of the quality variation found in eggs from flocks of uniform age managed under similar conditions showed that a small sample of eggs randomly selected from these flocks each week was highly accurate in reflecting the average quality of the lot.

Based on the extensive research and the statistical analyses, USDA implemented a quality control program in 1959. This program made possible the marketing of high-quality eggs from the controlled flocks under the fresh fancy or AA label of identification. A program to market grade A eggs under the quality control program was also made available with less stringent requirements than the fresh fancy or AA program.

A small sample of eggs was randomly selected from flocks under the programs. These eggs were then broken out and the height of the thick white measured with a micrometer and the reading correlated with the weight of the eggs. This resulted in a Haugh unit figure used to determine the quality of the egg. The higher the Haugh unit, the higher the quality of the egg. While the programs were excellent marketing tools for high-quality eggs, their use was very limited. The fresh fancy quality program practically ceased and the grade "A" program was not used. Special handling was required for these programs, and additional equipment and facilities were required beyond those for the regular voluntary programs. The use of these programs probably was restricted by their cost and the fact that producers and packers did not receive premiums for the product sufficient to justify the costs. Thus the programs were eliminated in 1981.

Equipment

For economy in time and preservation of the product, the following equipment should be available to persons engaged in breaking eggs for the purpose of measuring height of the white as well as yolk and white condition.

1. A flat glass surface approximately 12 by 18 inches or larger. The glass should be placed on a metal stand having adjustable legs for leveling. A mirror of approximately the same size as the glass is needed for observing the under side of the egg. The stand should be set on a table of such height that the dial of the micrometer will be at eye level when in use, as shown in figure 14.

2. A standard individual egg scale that indicates the weight in ounces per dozen for each egg. A test weight should be used to check the scale at the start of the breaking operation and any time the scale is moved.

3. A knife and breaking tray obtained from a supply house dealing in egg-breaking equipment is very convenient for opening the eggs.

4. A micrometer mounted on a tripod such as illustrated in figure 15 is satisfactory to measure the height of the thick white. It should be graduated to read in tenths of a millimeter.

Another type of instrument for measuring the height of the thick white is also available. It is similar in most respects to the one illustrated in figure 16 except that there is a provision made for setting the weight of the egg on a graduated dial on the face of the instrument. The instrument is so graduated to get the direct Haugh unit reading (fig. 16).

5. A Haugh unit conversion chart illustrated as exhibit A is used to establish Haugh unit readings for broken-out eggs.

Application of this chart is simple. After the egg weight is determined and the white is measured, locate the micrometer reading in the proper weight column. The Haugh unit reading is found directly above or below the properly located micrometer reading in the column marked "Haugh Units."

6. A squeegee is handy to move the broken egg from the glass surface to a suitable container.

7. Liquid containers, churning equipment, and holding facilities are needed in accordance with the disposition made of the broken-out eggs.

Procedure

Comparable results can be obtained only if uniform procedures are used.

Since eggs for top quality must have practically normal shells, the grader should select only such eggs when obtaining the sample for condition examination of white and yolk. The eggs should be cooled or tempered to a uniform temperature. It is generally agreed that eggs should be cooled at the farm to 60° F. or below and that the temperature should not be permitted to rise above that through the marketing channels.

Care must be taken in using the breaking knife so the thick white is not ruptured. Consistent results can best be obtained by using a breaking knife. Blunt edges, such as a table edge,

may cause the shell to splinter, with the possibility of puncturing the thick white. The egg should be held as near the glass as possible and the contents emptied very gently from the shell.

In some eggs the envelope of thick white is rather firmly attached to the shell membrane in the small end of the egg. When this is noted, rupture of the thick white can generally be prevented by slowly raising the half shell. White heights should not be recorded of eggs when the thick white has been mechanically ruptured or when the yolk membrane is ruptured for any cause.

The surface on which the egg contents are placed must be level. One egg at a time should be broken since it is important to measure the white height immediately after breaking. A delay of a few minutes can make a difference in the Haugh unit reading.

The micrometer must be checked before using. Set it on the glass and turn the measuring rod down until it touches the surface of the glass on which the broken-out egg will be placed. To be sure that the rod is actually touching the surface of the glass, push the edge of a thin sheet of paper against the intersection of the rod and the glass. The face of the micrometer is then turned so that the indicator will read zero. The procedure should be repeated from time to time during the breaking operation to be sure that the micrometer is properly adjusted.

When determining white quality with a micrometer, select a flat area in the surface of the widest expanse of the thick white for measurement. Eggs with very high whites will not have a flat surface and in such cases a point about halfway between the yolk and the edge of the widest expanse of thick white should be selected. Care should be taken to avoid measuring areas over an air bubble or chalaza. The measuring rod should be rolled down slowly until it makes contact with the surface of the white and should be raised and cleaned before placing over the next egg to be measured.

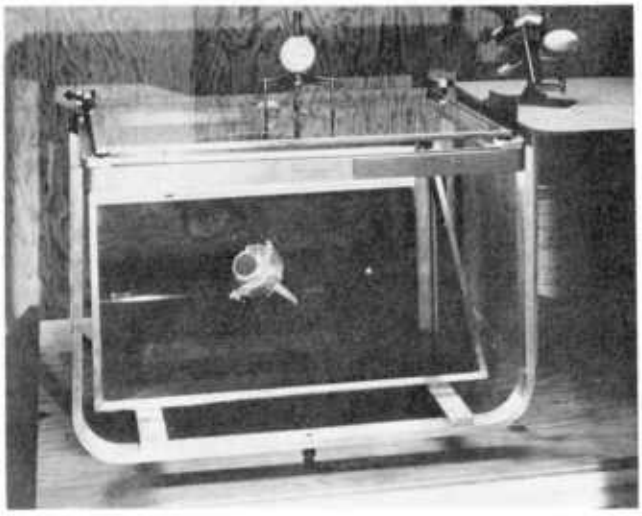

Figure 14.—Metal stand with mirror and level. BN-7999

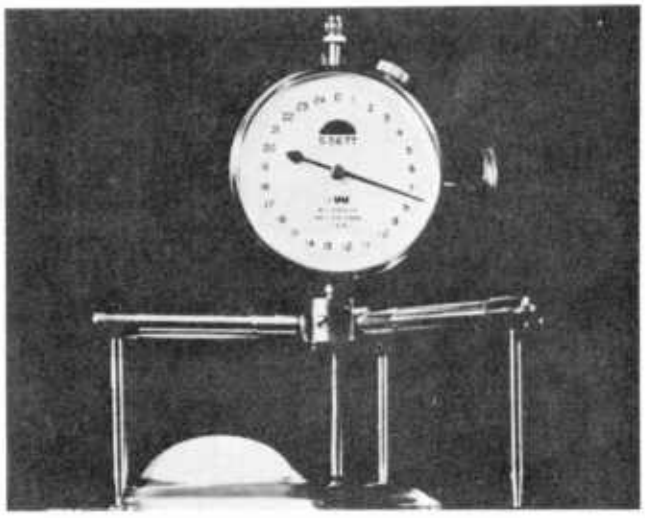

Figure 15.—The micrometer or height gage for measuring the height of the thick white. Gage shown here in position over an egg. BN-5862

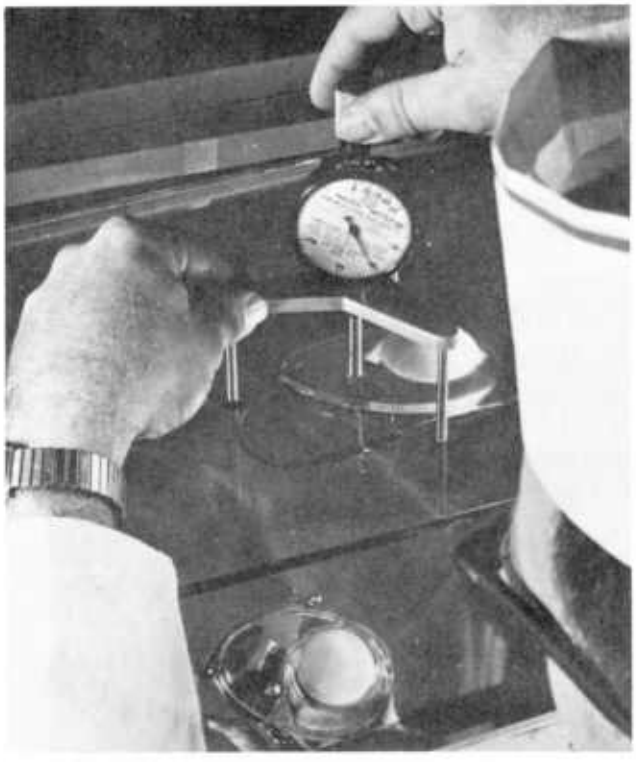

Figure 16.—Break-out examination using a micrometer which gives direct reading in Haugh units. ST-2812-11

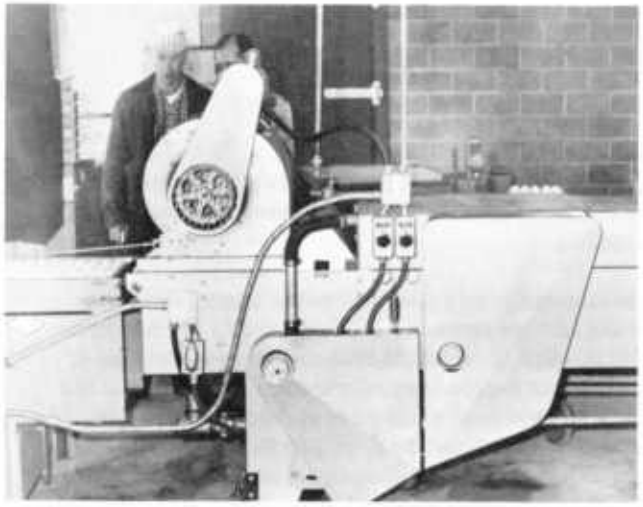

Figure 17.—Automatic egg washer—as used in large volume operation. BN-21149

Figure 18.—Operator loading eggs onto the grading and packing line at the in-feed conveyor. BN-10929X

Figure 19.—Eggs on the flash-candling area of the in-feed conveyor. 0272B178-27

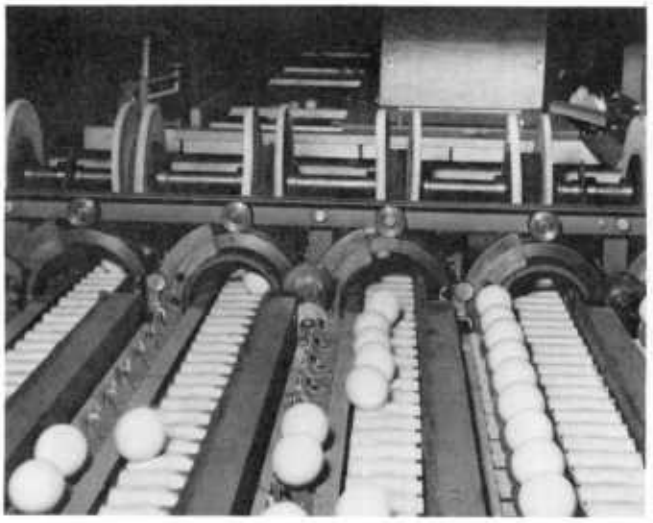

Figure 20.—In-line scales. Eggs of different sizes are weighed and ejected at different points on the line. BN-31672

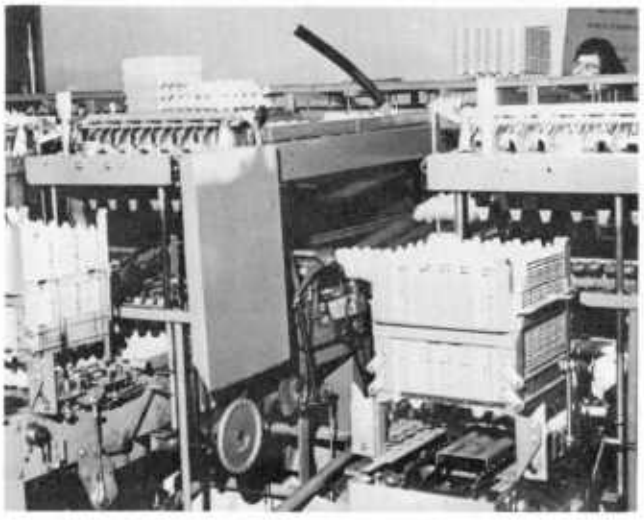

Figure 21.—Automatic egg-packaging equipment. 027B175-3

Figure 22.—Product coming off automatic packaging equipment. BN-27261

Automatic Egg-Candling and -Weighing Facilities

The high-quality egg produced under the modern, large-scale, controlled flock system lends itself very well to handling and processing by automatic equipment.

Machine mass scanning devices are used extensively to detect checks, irregular shells, meat and blood spots, and loss eggs. Automatic weighing equipment diverts the variously sized eggs into separate bins for packaging. Automatic packaging equipment places the eggs into cartons and also closes the cartons.

Modern washing equipment is designed to wash, sanitize, and dry eggs automatically. It now is possible to accomplish washing, segregation of checks, spots, and loss, sizing of the eggs, and automatic packaging, all in a continuous line using automatic equipment.

Figures 17 through 22 illustrate the various types of equipment described above. Figure 23 illustrates a typical layout of an automated egg-handling and -processing operation.

In order to grade eggs with maximum efficiency, adequate facilities must be provided. The principles outlined here are applicable to facilities used by people doing quality control work and to those plants where quality segregation is accomplished by hand candling.

Candling Room

The candling area should be darkened to the extent necessary to do an efficient job. The extent of darkness will vary depending on the type candling equipment being used.

In hand candling operations, it is desirable to paint the walls of the room with a dark-colored, flat finish to avoid light reflection. There should be no cross beams of light between the candler and the candling light. The candling light should be properly adjusted and focused to give better and more uniform candling results. The light should be at about elbow height for the candler and placed so that the light does not shine in the candler's eyes.

When mass scanning devices are used, the candling area should be enclosed or surrounded by a black cloth to prevent entrance of outside light. The light rays from the scanning device should be focused away from the candler's eyes. On high production machines, it is generally best to alternate the candler with some other job to prevent eyestrain, break the monotony, and improve efficiency of the candling operations.

The space required for graders and equipment will vary greatly depending on the type of operation and capacity needed for amount of product handled.

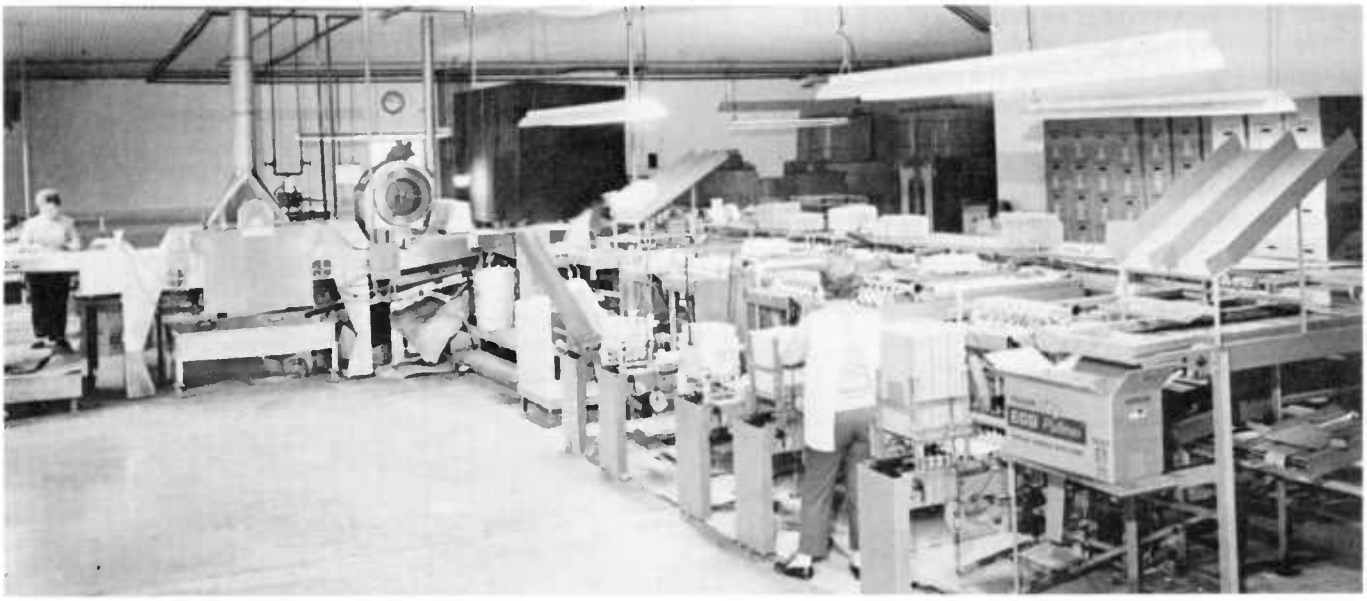

Figure 23.—Automated egg-handling equipment. 0272B176-32

The floors should be of smooth concrete, coved into wall intersections, and pitched to trapped floor drains. This construction will make possible floor washdown and will help reduce off odors. If foot mats for graders are used, they should be of a material that can be washed without moisture penetration; and consideration may be given to artifically heated foot mats.

Sufficient overhead lights should be provided to facilitate cleaning up the room.

It is recommended that the grading room be equipped with a forced-air ventilator that provides cool air in warm weather and heated air in cool weather. Additional facilities might include a humidifier and year-round air conditioner. It is essential that the forced-air inlet deflect incoming air so that it will not blow directly on the workers and that the control switch be located outside the grading room, accessible only to the foreman of the candling room.

Weighing Equipment

Individual Egg Scale. Each candling bench should be equipped with an individual egg scale. An accurate check weight should be provided.

Automatic Egg Scale. There are many types of automatic and semiautomatic egg-weighing devices that can be installed in the egg-grading line. The weighing accuracy of automatic equipment should be checked at the beginning of each shift and periodically during the shift. When the weighing is done by electric contact at the scale balance, it is important to be careful that dust and moisture don't foul the contact points.

When weighing is done by having the egg stop its forward motion just before the scale beam is released automatically, it is important that the egg come to rest completely before weighing begins.

Test weights should be provided for testing the accuracy of automatic weighing equipment.

Federal-State Grading Programs

For over 60 years, USDA in cooperation with the various States has conducted a voluntary Federal-State egg-grading service. The legislation authorizing this service provides that it be conducted on a self-supporting basis financed from fees charged the applicants.

The grading service is based on the U.S. standards for quality of individual shell eggs and the U.S. grades and weight classes for consumer grades, for wholesale grades, and for the nest run grade of shell eggs. In addition, contract purchase specifications serve as another basis for performing grading or inspection of lots of eggs tendered for delivery under purchase agreements. The various purchase specifications are, of course, based on the U.S. standards for quality of individual shell eggs.

The first quality standards for individual eggs were developed in 1925.

In the early days of the Federal-State grading service for poultry and eggs, the work consisted largely of examining eggs and poultry purchased by the US. Navy, to determine compliance with procurement specifications. Grading and inspection service of this type gradually was extended to other Government agencies and private institutions that purchased eggs and poultry products.

Grading offices were established at the important terminal markets along the east and west coasts as well as in the inland terminal markets, such as St. Louis, Mo., and Chicago, Ill. These offices, in addition to providing grading service for eggs, poultry, and poultry products, handled the market news reporting activities which began at about the same time.

The growth of the service was slow at first, but expansion continued at a steady pace during the thirties. The most rapid expansion occurred during World War II in connection with Government buying programs for the Armed Forces and lend-lease activities.

The use of the services and the volume of products inspected and graded continued to expand after the end of hostilities. This expansion was due in part to the price-support programs that followed and to the fact that firms had previous experience with Federal-State grading and inspection programs and were continuing to use them in their processing and marketing programs.

It was during the war period that resident grading and inspection programs developed into major importance. Under these programs a qualified USDA-licensed grader or inspector, whose duties included the grading of shell eggs in accordance with U.S. standards and grades and the supervision of egg-breaking and drying operations, was placed in the processing plant.

With the advent of the "resident grader" type of service the volume of products graded and inspected on a "fee basis" became proportionately less important, considering the overall volume officially graded and inspected. Resident graders are used in the producing areas as well as in the distribution centers. The resident type of grading service offers several advantages over the terminal market of fee type of grading service:

(1) Grader is constantly available to grade and certify the pack, whether in cartons or loose.

(2) Grading is likely to be more uniform because the grader is continuously available to check the accuracy of the various candlers in the egg-grading room.

(3) Cost of resident grading service is less per unit than intermittent fee grading when a substantial part of the eggs handled are graded.

Regulations Governing Grading of Shell Eggs

USDA's grading services for shell eggs are permissive, in that individuals, firms, or Governmental agencies that desire these services may request them on their own volition. Services are performed on the basis of the Regulations Governing the Grading of Shell Eggs and U.S. Standards, Grades, and Weight Classes for Shell Eggs. The regulations explain how interested persons may apply for grading service, including appeals and regradings.

Application for intermittent grading service on a fee basis is usually made by telephoning the local USDA grading office, by personally contacting a grader in the vicinity, or by contacting the State supervisor's office. Prospective applicants for egg-grading service may also contact USDA in Washington, D.C., regarding the availability of grading service in their areas.

Application for resident grading service is made on special forms which specify that the applicant agrees to comply with the regulations which include the schedule of charges for service.

Federal-State grading service is performed by USDA-licensed graders who are supervised by the State, regional, and national supervisors of the service. Graders may be either State or Federal employees.

Cooperative Agreements

The Federal-State egg grading service is conducted under cooperative agreements between USDA and one or more cooperating parties within each of the States where service is available. The agreements are usually made with State departments of agriculture.

State colleges and the extension services often cooperate in the educational aspects of the grading program by providing training for prospective graders and by explaining the Federal-State program to producers, handlers, and consumers.

State departments of agriculture are usually responsible for the administative phases of the program within their States. The cooperative agreements vary from State to State from the standpoint of leadership and other responsibilites.

There are two main types of agreements—State Trust Fund and Federal Trust Fund. Under the State Trust Fund agreement, fees charged are collected and held in trust by the State. The applications for service are between the State and the individual firms, and the resident graders are State or Federal employees. To cover the cost of the Federal supervision of the program, the cooperating State periodically reimburses USDA from the State Trust Fund.

Under the Federal Trust Fund agreement, the contracts for services are between USDA and the individual firms, and the fees are collected and held in trust by USDA. The employees doing resident grading work are State or Federal employees, and the State is paid periodically out of the trust fund an amount in accordance with the terms of the agreement.

Costs of Service

The legislation that authorizes Federal-State egg-grading programs provides that the costs of the service be covered by fees charged persons who apply for grading and inspection services. Schedules of charges have been established to cover these costs. Included as cost items are the salaries and fringe benefits of the graders who perform the service, travel costs incurred in connection with grading activities, clerical assistance in typing certificates and maintaining necessary office records, supervisory costs at the field level, and administrative and overhead costs at the Washington level.

The charges for grading shell eggs on an intermittent or "fee basis" are based on the time required to render the service. Fees for grading service performed on a resident or continuous grading basis are set forth in the regulations. They are based on the cost to USDA of furnishing the grader or graders to the plant, plus an overhead administrative charge, based on the volume of the product handled in the plant, to cover supervisory and other costs.

Salaries of Federal resident graders are based on the U.S. government's General Schedule (GS) rates on a national basis. The fee schedules applicable to terminal market or fee grading are updated from time to time as costs change. Whether the grading is done on a fee basis or a resident basis, the cost will generally average only a fraction of a cent per dozen eggs.

Grade Labeling

Under the Federal-State grading program provision is made for the grade identification of the packaged product, whether packed in a 30-dozen case or a one-dozen carton. Usually the grade mark is applied to 30-dozen cases by means of a rubber stamp (fig. 24). The stamp also specifies the date the eggs were graded. In many instances when eggs are packed for delivery on purchase contracts to institutions, a paper tape must be placed across the top of the case, and the grade mark or acceptance mark (fig. 25) is stamped partially on the tape and partially on the case to effectively seal the case.

Some truck shipments of officially graded cartoned or loose eggs are not stamped with a grade mark. The trucks may be sealed by the grader and the seal number recorded on the certificate. The buyer and seller rely on the grading certificate to give the grade and percentages of the various qualities in the lots.

The greatest use of the grading program is in the grade labeling of individual cartons of one dozen eggs to inform consumers of the quality. The regulations provide for the approval of cartons and grade labels that are used in the labeling program for consumers.

The grade mark used on official grade labels is contained in a shield design. It contains the letters USDA and the grade. It may contain the size and/or a phrase such as "Federal-State Graded." The grade mark is printed on the carton (fig. 26). If the egg size appears on the main panel of the carton, it need not be shown in the grade mark. The date of grading corresponding to the consecutive calendar day of the year the eggs are actually packed in the carton must be shown on the carton.

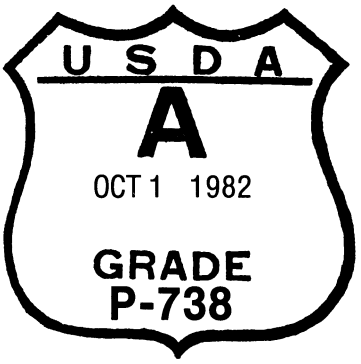

Figure 24.—Official grade stamp for use in approved plants operating under USDA resident grading service.

Figure 25.—Official mark to indicate acceptance under institutional purchase contracts. BN-25494

Figure 26.—Official grade mark for use on cartons packed under continuous supervision. BN-30473

Prerequisites to Packaging Eggs with Grade Identification Labels

Several requirements must be met before cartoned eggs may be grade labeled:

1. The eggs must be graded by and identified under the supervision of a licensed grader. The eggs may be graded by an authorized company employee, but then must be check-graded by the supervising greader.

2. Eggs to be packed in consumer packages and marked U.S. grade AA, U.S. grade A, or U.S. grade B must be packed from eggs of current production.

3. Establishments packing eggs with official marks in consumer packages must meet the facility and operating requirements set forth in the USDA regulations.

Legislation Affecting Grading and Marketing of Eggs

Much legislation has been enacted to regulate the sale of shell eggs. The laws apply to the edibility of the product and to its quality and grade. Both Federal and State laws are applicable to eggs, but practically all of those pertaining to candling and grading have been enacted by the States.

Federal Laws

The Farm Products Inspection Act of 1917 provided the original authority for establishing grades and grading service for voluntary use. Beginning in 1925, this authority was provided each year by an act of Congress that also provided the USDA appropriations.

The Agricultural Marketing Act of 1946 contains the authority under which the present grading service is performed and authorizes the development of standards.

The U.S. standards for quality of individual shell eggs serve not only as a basis for establishing U.S. grades, but also for developing State standards and grades and "commercial"grades.

The Egg Products Inspection Act (Public Law 91-597), which became law in 1970, provides for the uniformity of standards and grades. The Act states; "For eggs which have moved or are moving in interstate or foreign commerce, no State or local jurisdiction may require the use of standards of quality, condition, weight, quantity, or grade which are in addition to or different from the official Federal standards." This has prompted States with egg laws in which the standards and grades differ somewhat from the official Federal standards and grades to amend their laws to comply with the Federal standards.

A provision on labeling prohibits States from requiring labeling on eggs from other areas to indicate the State or other geographic area of production or origin. This provision does not apply to Alaska, Hawaii, Puerto Rico, or the Virgin Islands.

The act also controls the disposition of certain undergrade eggs to prevent their getting into consumer channels. These eggs are defined in the act as "restricted eggs" and include checks, dirty eggs, incubator rejects, inedibles, leakers, and loss eggs. Checks and dirties can move to official USDA egg breaking plants where they can be handled and processed properly. All other restricted eggs must be disposed of in a way that prevents their use as human food. They could be denatured with a color dye or other approved materials and be used in animal foods.

The Federal Food, Drug, and Cosmetic Act and the regulations for its enforcement apply to all food products in interstate commerce including shell eggs. This act is designed to prevent the shipment of adulterated and misbranded foods. In applying this act to such eggs a small tolerance for loss eggs is permitted, as it would be rather difficult, costly and impractical to eliminate all loss eggs from wholesale quantities of eggs.

The Federal Trade Commission has responsibility for regulating the business practices engaged in by firms marketing eggs in interstate or foreign commerce.

State Laws

In 1919, the first State egg laws were enacted in South Dakota, Iowa, and Illinois. The earliest regulations mainly prohibited the sale of inedible eggs. Since then, egg laws have been enacted in all of the 50 States. The laws regulate the labeling, grading, and marketing of eggs and reference the U.S. standards, grades, and weight classes. The inspection of eggs at retail outlets for grade and weight compliance is basically the responsibility of State regulatory agencies under State egg laws. Some States require that loss eggs be removed by the first receiver.

New York was one of the first States to enact a law requiring that eggs be labeled by quality and size. New York egg producers hoped that proper labeling for quality, coupled with an intensive consumer education program, would cause consumers to be willing to pay more for top quality. They believed that local producers would benefit because of the higher yield of top quality eggs that packers could obtain from their eggs. Today most States have labeling requirements and require licenses or permits for the sale of eggs.

The provisions of the Egg Products Inspection Act concerning standards and grades and labeling have helped to assure the free movement of eggs in interstate commerce and eliminate features in State eggs laws that tend to act as trade barriers.

Egg production is a major agricultural industry in the United States. In 1981, total egg production was over 5.8 billion dozen.

Producing and marketing this volume of eggs have been accompanied by the need for quality and specialization. Breeding, hatching chicks, raising chickens, producing eggs, and producing poultry meat have each become specialized areas of production. However, in some cases, large, vertically integrated firms may perform several or all of these functions.

Breeding

Shell color and thickness, egg size, quality and quantity of thick white, quantity of eggs produced, and, to some extent, freedom from blood spots are hereditary factors and can be bred into the egg-laying flock. The baby chicks or pullets for the initial flock or flock replacement should be procured from a source that can give reasonable assurance that these factors have been carefully considered in the breeding program.

Hatching

To promote improved breeding and production qualities in poultry and to reduce losses from pullorum disease, the industry established the National Poultry Improvement Plan in 1935.

The Plan is administered jointly by USDA's Agricultural Research Service and an official State agency in each of the cooperating States. It operates according to regulations and standards under which birds — classified with respect to specific breeding qualities and freedom from pullorum disease — and hatching eggs may be produced and marketed by poultrymen. Procurement of baby chicks from "plan" hatcheries assists the producer in the selection of desirable young stock.

Brooding and Raising

The brooding of baby chicks and raising them to laying age may be done by one who raises poultry for the eggs or by specialists in the pullet-raising field. Egg producers in a number of areas today follow the practice of culling their flocks carefully or entirely replacing them with laying-age pullets after their flocks have completed their first year of production. This practice eliminates for the specialized egg producer an outlay for additional space and labor, as well as the hazards of raising additional birds.

If the egg producer is considering brooding and raising flock replacements, it is necessary that thought and careful planning go into the following:

(1) Selection of the source of baby chicks.

(2) Providing separate quarters with sufficient space for raising birds to pullet age.

(3) Management know-how regarding handling, feeding, watering, vaccination, and sanitation.

Housing

Proper housing is essential for efficient egg production. Birds that are comfortable are healthier, and production costs are lower, than under improper conditions. Good sanitation is very important. Waterers and feeders, whether the manual or mechanical type, should be kept clean. Dirt and dust should be held to a minimum. Controlled ventilation and, where necessary, adequate insulation should be provided to have the proper temperature and humidity conditions. Overcrowding should be avoided, and the equipment and facilities should be kept in good condition.

Currently, over 90 percent of all table eggs produced in the United States are from caged layers, primarily because of economics. Eggs produced in cages cost less to produce than those in floor systems due to much more intensive labor and floor space requirements with the latter. The most modern cage systems are completely automated with mechanical feeding and watering equipment and conveyor belts that carry the eggs out of the laying house.

Production of High-Quality Eggs

Feeding shares the limelight with breeding in the production of high-quality eggs.

Shell — The breaking strength of an egg is affected by the hen's feed, breeding, age, and freedom from disease, and by hot weather. Today the average commercial feed supplemented with "grit" (calcium carbonate) usually has sufficient calcium, phosphorus, manganese, and vitamin D to produce sound shells. Therefore, the source of shell trouble is more frequently found in some of the other factors mentioned.

Yolk — Dark pigmentation in the yolk affects the acceptability of the egg in the top qualities. Rations high in yellow grains and green feeds produce dark yellow to orange-colored yolks. Rations high in green grasses, silage, and cottonseed meal

(gossypol not removed) will cause the yolks to acquire a reddish or olive color.

White — To be of top quality, eggs must have a high percentage of thick white. A lack of this factor can be attributed to breeding and disease of the chickens, and to improper care of the egg after production.

Care of Eggs on the Farm

Immediately after it is laid, an egg begins to lose quality even if it is removed from the nest, cooled, packed, and marketed promptly (fig. 10).

Keeping temperature and humidity conditions at an optimum level retards this loss in quality to a large degree. The necessary steps are:

(1) Gather eggs frequently (at least 3 times a day).

(2) Handle the eggs carefully to prevent breakage.

(3) Cool the eggs promptly.

(4) Pack the eggs in clean, cool packing materials.

(5) Pack clean eggs separately from dirty eggs.

Cleaning Eggs on the Farm

Even with good farm-management practices and careful handling, a small percentage of dirty eggs will be produced. Producers must bear in mind that dirty eggs are covered with bacteria that will cause spoilage if they enter the egg. Farm cleaning, therefore, must be performed in a manner that will minimize the chances of bacterial penetration of the shell. If these important facts are forgotten, and eggs are washed carelessly, more damage can be done than by leaving the dirt on the shell.

Wetting a dirty shell provides moisture in which bacteria may breed and assists their growth and penetration through the shell. A washing solution colder than the egg causes the egg content to contract and thus allows polluted water to be drawn through the shell. When washing eggs the following precautions shall be followed:

1. Wash eggs with water at least 20° F. warmer than the eggs and at a minimum of 90° F.
2. Select a detergent or detergent sanitizer that is compatible with the wash water and one that will not give off foreign odors that may be imparted to the egg.
3. Keep wash water as clean as possible.
4. Rinse by spray with water slightly warmer than the wash water.
5. Use an approved sanitizer in the spray rinse.
6. Do not case wet eggs.

Marketing

Eggs from farms should be marketed promptly in clean containers protected from transportation shock, wind, heat, or extreme cold. Refrigerated trucks during warm weather and insulated trucks during extreme cold should be used to handle the movement of eggs from production facilities through the marketing process.

It is wise to select a marketing firm that pays the producer on the basis of quality rather than on a single price basis. Payment on a single price basis makes it necessary to lower the price for top quality to compensate for lots having a high percentage of low-quality eggs.

In addition, producers should be satisfied that the grading station is equipped to handle their products efficiently. The well-equipped grading station should have refrigerated truck service for farm pickup of quality eggs during the summer and insulated, or possibly heated, trucks for use during severe winter weather.

When received at the plant and before they are graded, eggs should be put into a cool (50° to 60° F.) humidified room.

Grading and Packing

Grading should take place in a cool, darkened room properly equipped and operated by trained and carefully supervised graders. In many plants grading rooms are now air-conditioned. The grading room should be arranged to minimize lost motion by graders and grading room helpers.

It is necessary to develop and maintain a receiving, handling, and shipping supply control of ungraded and graded eggs.

After eggs are graded and packed in cases they should immediately be moved to the shipping room cooler and held there until ready for distribution. If they are distributed direct to the retail store, a refrigerated truck should be used for summer deliveries and an insulated truck for winter deliveries. This practice will not only help to deliver the quality of eggs as graded to the retailer, but also will stress to the retailer the need for proper care of the product.

Packing is normally carried on in conjunction with the grading operation. Clean packaging materials should assure adequate protection of the product in the handling required in the grading station, distribution channels, and in the retail store.

Distribution

Wholesale. Eggs for wholesale outlets should be packed in new or good used cases and packing materials. The great majority of shipments today are by truck. Trucks hauling eggs should be refrigerated by a self-contained refrigerator unit and insulated on all surfaces and doors for warm weather shipments.

For deliveries in winter weather, the truck should be equipped with a warm air heating unit. Truck beds should be equipped with racks to provide adequate air movement around the load. Before loading, trucks should be checked to make sure that the interior is clean and free from foreign odors, and that there are no breaks in the walls, ceilings, or floor surfaces.

Retail. High-quality eggs that have been properly cared for during packing in attractive cartons are sometimes handled carelessly by the retailer.

Proper stock control and care, including volume delivery, rotation of supply, refrigeration (50° to 60° F.), and humidity, are necessary.

Bulk stocks should be stored only under refrigeration in a space that is free from volatile odors of any kind.

Grading schools are an effective means of teaching the proper methods and practices of grading and related subjects. This part of the manual is a guide for those who wish to organize and conduct egg-grading schools.

Planning

As is the case in most successful undertakings, good planning is a highly important phase in conducting an egg-grading school. The planning should cover ways and means of financing the school as funds will likely be needed for supplies of eggs, packing materials, rentals, manuals, and other equipment.

Consideration could be given to charging a laboratory or registration fee to cover the necessary expenses in conducting the school. An adequate number of instructors and staff assistants should be provided to help with the instruction and to assist in setting up laboratory classes and demonstrations.

Location and Time

The school should be held as nearly as possible in the center of the region from which the students are drawn. It should be held in a place where the essential equipment and facilities are available and where there is adequate space for classes and laboratory practice sessions. Consideration should be given to locating the school near a place where meals and lodging facilities are available at reasonable rates.

Egg-grading schools can be held at anytime during the year, but it is desirable to schedule a time when the regular work of the prospective students is not too pressing and when there is a minimum of conflict with other meetings, expositions, and special schools. Generally, it is desirable to hold school in the late winter or early spring months, although other times of the year may be equally as desirable.

Equipment and Facilities

Facilities and equipment of sufficient size and quantities to accommodate the number of students and instructors attending the school should be provided as follows:

1. A room equipped with tables and chairs for lectures and demonstrations.
2. A room for laboratory sessions and demonstrations. An egg-grading or an egg-breaking plant that is not in current use would be a desirable place to hold the school if a room suitable for the lecture sessions is available.
3. A supply of fillers, flats, filler-flats, and egg cases.
4. An adequate supply of candling lights mounted to provide ample bench space, candling light apertures at correct height, and adequate case light. These must be located in a room that can be darkened.
5. An adequate supply of shell eggs. The working stock of shell eggs must include the entire range of quality, including various types of loss and inedible eggs. It is desirable to have eggs which cover the complete range of quality in each of the quality factors. These are necessary for laboratory practice sessions as well as for testing and examination purposes.
6. Individual egg scales and scales for weighing 15 or 30 dozen eggs.
7. Slide and film strip projectors, motion picture projector, blackboard, overhead projector, and other similar equipment as needed.
8. Other materials, such as egg quality slides, manuals, a supply of specifications of standards and grades, pads, pencils, and examination papers.
9. Registration blanks, supply of programs, and laboratory forms.
10. Certificates for those who successfully complete the school.

Program

The information about eggs contained in this manual can serve as the course outline for an egg-grading school. It can be presented as a 1-day refresher school for egg graders, or expanded into a 2- to 5-day school allowing each subject to be explored in greater detail.

The program can be supplemented with appropriate slides, filmstrips, films, and other visual aids. Occasional technical lectures can be introduced. Laboratory classes and practice sessions are also valuable components to egg-grading schools.

Suggested Format for an Egg-Grading and -Marketing School

Essential subjects (covered in this manual).	Supplemental activities and topics to use as time permits
Registration	
Purpose and plan of the school	
Formation, structure, and composition of the egg	Film
The grading of eggs—advantage of grading; general application of standards and grades	Laboratory: Transferring eggs out of and into cases, fillers and flats
Weight classes	Laboratory: Weight classing Use of the individual egg scale
The general quality factors for individual eggs	Egg quality slides
Exterior quality determination	Laboratory: Classifying eggs as to shell factors Segregating of stains and dirties "Belling" for soundness of shell
Candling and interior quality determination	Laboratory: Candling room technique Candling light Mass scanning equipment Rotation and candling with two eggs in each hand
Air cell requirements	Laboratory: Classifying eggs as to air cell factor
Review of yolk and white quality determination	Laboratory: Classifying eggs on the basis of the yolk factor and white factor Demonstration of broken-out quality of eggs Comparison of broken-out appearance with candled appearance Establishing the grade on a lot of eggs
U.S. Standards for Quality of Individual Shell Eggs	Proposals for changes in standards, grades, and regulations
The production and maintenance of egg quality	Shell treatment of eggs Sanitation requirements and operating procedures applicable to grading and packing
Federal-State grading programs and laws that relate to egg marketing	Delivering to the consumer eggs of the quality represented on label and what the consumer wants New trends in egg quality and egg marketing research
Review and question-and-answer period	Laboratory practice
Practical examination	
Written examination	
Award of certificates of completion	
Adjournment	

Shell Egg-Grading Laboratory

It should be remembered that the more practice sessions in candling that are provided, the better understanding the students will have of egg grading. The instructors responsible for setting up the laboratory classes should include a wide variety of qualities within the various lots of eggs used in instruction. The selection and arrangement of the lots for student practice and testing is quite important and will influence considerably the success of the school.

The laboratory procedure should include demonstrations of grading room practice, correct candling technique, classification with respect to quality factors for individual eggs, and segregation with respect to weight class. In order to reduce confusion and fix the standard for each factor in the beginner's mind, each quality factor should be considered separately for a number of lots.

Each student should classify various lots of eggs as the instructor corrects or adjusts interpretation and technique. After the student becomes reasonably accurate in interpreting each quality factor considered separately, a trial lot or two should be considered for all factors simultaneously. The broken-out egg quality should be compared with the quality interpretation by candling, and misinterpretations adjusted.

Each student should also be familiar with the use of a micrometer to measure the height of the thick white to determine quality by the break-out method.

Exhibits B through F in this manual are forms to be used to record quality factors in laboratory work.

For further information and training aids

Application for grading service;

Regulations concerning the standards, grades, and weight classes for shell eggs;

Suppliers of equipment used to measure egg quality;

Official egg air cell gage; and

Information on ordering the Egg-Grading Manual and wall charts illustrating egg quality, write:
Poultry Division, AMS, USDA,
Washington, DC 20250

****

Photos in this manual, and
Egg quality slide set or filmstrip, write:

Photos and slide set for sale—
Photography Division, GPA, USDA
Washington, DC 20250

Filmstrip for sale —
Photo Lab, Inc., 3825 Georgia Avenue, NW,
Washington, DC 20011

****

Egg quality film, write:

Sale —
Order Section, National Audiovisual Center, GSA,
Washington, DC 20409

Loan —
Land-grant university film libraries; or Information Division, AMS, USDA, Washington, DC 20250.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

U.S. DEPARTMENT OF AGRICULTURE, AMS
GRADING BRANCH, POULTRY DIVISION

HAUGH UNIT CONVERSION CHART

(1-6-60)

Egg Weight	HAUGH UNITS																			Egg Weight
	55	56	57	58	59	**60**	61	62	63	64	**65**	66	67	68	69	**70**	71	72	73	74	
	(MILLIMETERS)																				
18	2.8	2.9		3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2 4.3	4.4	4.5	4.6	4.7	18
19	2.9	3.0	3.1	3.2		3.3	3.4	3.5	3.6	3.7	3.8	3.9 4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8 4.9	19
20	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6 4.7	4.8	4.9	5.0	20
21	3.2	3.3		3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6 4.7	4.8	4.9	5.0	5.1 5.2	21
22	3.3	3.4	3.5		3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7 4.8	4.9	5.0	5.1	5.2 5.3	22
23	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.1		4.2	4.3 4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2 5.3	5.4	23
24	3.5	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2 5.3	5.4	5.5	24

Egg Weight	HAUGH UNITS																			Egg Weight
	55	56	57	58	59	**60**	61	62	63	64	**65**	66	67	68	69	**70**	71	72	73	74	
	(MILLIMETERS)																				
25	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2 5.3	5.4	5.5	5.6	25
26	3.8	3.9		4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2 5.3	5.4	5.5	5.6	5.7 5.8	26
27	3.9	4.0	4.1		4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3 5.4	5.5	5.6	5.7	5.8 5.9	27
28	4.0	4.1	4.2	4.3		4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4 5.5	5.6	5.7	5.8	5.9 6.0	28
29	4.1	4.2	4.3	4.4		4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4 5.5	5.6	5.7	5.8	5.9	6.0 6.1	29
30	4.2	4.3	4.4		4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.5	5.6 5.7	5.8	5.9	6.0	6.1 6.2	30

Egg Weight	HAUGH UNITS																			Egg Weight
	55	56	57	58	59	**60**	61	62	63	64	**65**	66	67	68	69	**70**	71	72	73	74	

Egg Weight	HAUGH UNITS																															Egg Weight
	75	76	77	78	79	**80**	81	82	83	84	**85**	86	87	88	89	**90**	91	92	93	94	**95**	
	(MILLIMETERS)																					
18	4.8 4.9	5.0	5.1	5.2 5.3	5.4	5.5 5.6	5.7	5.8 5.9	6.0	6.1 6.2	6.3	6.4 6.5	6.6 6.7	6.8 6.9	7.0	7.1 7.2	7.3 7.4	7.5 7.6	7.7 7.8	7.9 8.0	8.1 8.2	18
19	5.0	5.1	5.2 5.3	5.4	5.5 5.6	5.7	5.8 5.9	6.0	6.1 6.2	6.3	6.4 6.5	6.6 6.7	6.8	6.9 7.0	7.1 7.2	7.3 7.4	7.5 7.6	7.7	7.8 7.9	8.0 8.1	8.2 8.3	19
20	5.1 5.2	5.3	5.4	5.5 5.6	5.7	5.8 5.9	6.0	6.1	6.2 6.3	6.4 6.5	6.6	6.7 6.8	6.9 7.0	7.1	7.2 7.3	7.4 7.5	7.6 7.7	7.8 7.9	8.0 8.1	8.2 8.3	8.4 8.5	20
21	5.3	5.4	5.5	5.6 5.7	5.8	5.9 6.0	6.1	6.2 6.3	6.4	6.5 6.6	6.7	6.8 6.9	7.0 7.1	7.2	7.3 7.4	7.5 7.6	7.7 7.8	7.9 8.0	8.1 8.2	8.3 8.4	8.5 8.6	21
22	5.4	5.5	5.6 5.7	5.8	5.9	6.0 6.1	6.2	6.3 6.4	6.5	6.6 6.7	6.8 6.9	7.0	7.1 7.2	7.3 7.4	7.5 7.6	7.7 7.8	7.9	8.0 8.1	8.2 8.3	8.4 8.5	8.6 8.7	22
23	5.5	5.6	5.7 5.8	5.9	6.0 6.1	6.2	6.3 6.4	6.5	6.6 6.7	6.8	6.9 7.0	7.1	7.2 7.3	7.4 7.5	7.6 7.7	7.8 7.9	8.0 8.1	8.2 8.3	8.4	8.5 8.6	8.7 8.8	23
24	5.6	5.7 5.8	5.9	6.0	6.1 6.2	6.3	6.4 6.5	6.6	6.7 6.8	6.9	7.0 7.1	7.2 7.3	7.4	7.5 7.6	7.7 7.8	7.9 8.0	8.1 8.2	8.3 8.4	8.5 8.6	8.7 8.8	8.9 9.0	24

Egg Weight	HAUGH UNITS																															Egg Weight
	75	76	77	78	79	**80**	81	82	83	84	**85**	86	87	88	89	**90**	91	92	93	94	**95**	
	(MILLIMETERS)																					
25	5.7 5.8	5.9	6.0	6.1 6.2	6.3	6.4 6.5	6.6	6.7	6.8 6.9	7.0	7.1 7.2	7.3 7.4	7.5 7.6	7.7	7.8 7.9	8.0 8.1	8.2 8.3	8.4 8.5	8.6 8.7	8.8 8.9	9.0 9.1	25
26	5.9	6.0	6.1	6.2 6.3	6.4	6.5 6.6	6.7	6.8 6.9	7.0	7.1	7.2 7.3	7.4 7.5	7.6 7.7	7.8	7.9 8.0	8.1 8.2	8.3 8.4	8.5 8.6	8.7 8.8	8.9 9.0	9.1 9.2	26
27	6.0	6.1	6.2	6.3 6.4	6.5	6.6 6.7	6.8	6.9 7.0	7.1	7.2 7.3	7.4	7.5 7.6	7.7 7.8	7.9	8.0 8.1	8.2 8.3	8.4 8.5	8.6 8.7	8.8 8.9	9.0 9.1	9.2 9.3	27
28	6.1	6.2	6.3 6.4	6.5	6.6	6.7 6.8	6.9	7.0 7.1	7.2	7.3 7.4	7.5	7.6 7.7	7.8 7.9	8.0 8.1	8.2	8.3 8.4	8.5 8.6	8.7 8.8	8.9 9.0	9.1 9.2	9.3 9.4	28
29	6.2	6.3	6.4 6.5	6.6	6.7	6.8 6.9	7.0	7.1 7.2	7.3	7.4 7.5	7.6	7.7 7.8	7.9 8.0	8.1 8.2	8.3	8.4 8.5	8.6 8.7	8.8 8.9	9.0 9.1	9.2 9.3	9.4 9.5	29
30	6.3	6.4	6.5	6.6 6.7	6.8	6.9 7.0	7.1	7.2 7.3	7.4	7.5 7.6	7.7	7.8 7.9	8.0 8.1	8.2 8.3	8.4	8.5 8.6	8.7 8.8	8.9 9.0	9.1 9.2	9.3 9.4	9.5 9.6	30

Egg Weight	HAUGH UNITS																															Egg Weight
	75	76	77	78	79	**80**	81	82	83	84	**85**	86	87	88	89	**90**	91	92	93	94	**95**	

CLASSIFYING BY WEIGHT

Egg No.	Extra Large	Large	Medium	Small

Exhibit B

CLASSIFICATION OF INDIVIDUAL EGGS

Use Terms or Letters Listed Below for Descriptive Purposes

Egg No.	Yolk	White	Air Cell	Interior Quality		Shell	
				Candled Quality	Haugh Unit	Quality	Defect
Terms	Classify yolk, White, and air cell separately as: AA, A, B, LOSS			Give final classification for *interior* quality as: AA, A, B, LOSS (Disregard Shell)		AA or A, B, Dirty, Checked, Leaker, Smashed	Identify defect if any

Exhibit C

CLASSIFYING BY SHELL FACTORS

Egg No.	Clean	B (Stain)	Dirty	Texture and shape		Checked
				Practically Normal	Abnormal	

Exhibit D

CLASSIFYING BY AIR CELL DEPTH

Egg No.	AA	A	B

Exhibit E

CANDLING STUDY—YOLK AND ALBUMEN

Use the Terms (letters) Below for Descriptive Purposes

	YOLK				WHITE		
Egg No.	Outline	Flat-tening	Defects	Remarks	Condi-tion	Clar-ity	Remarks
AA	Slightly defined	None	Practi-cally free		Firm	Clear	
A	Fairly well defined	None	Practi-cally free		Reason-ably firm	Clear	
B	Plainly visible	Flat	Serious		Weak, watery	1/8" or less Blood or Meat spot	

LOSS—Use the following abbreviations to describe:

BW—Bloody White	MLDY—Moldy Eggs	LS—Large Meat or Blood Spots
WR—White Rot	CE—Cooked Egg	L—Leakers
MR—Mixed Rot	BLRT—Black Rot	S—Smashed
SY—Stuck Yolk	BR—Blood Rings	FZ—Frozen Egg

Exhibit F